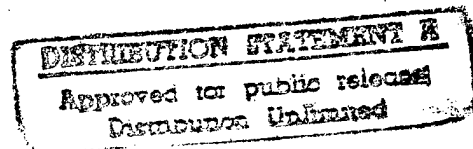


Energy Savings Opportunity Survey  
Energy Engineering Analysis Program (EEAP)  
Fort Campbell, Kentucky

*Final Report - Phase II*

*Volume 3  
Sections 4 (continued) - 14*

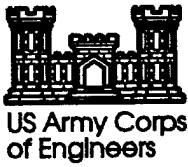


CONTRACT # DACA27-93-C-0096  
SYSTEMS/CORP PROJECT # 93006.01  
NOVEMBER 24, 1993

19971016 189

**SYSTEMS***corp*

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION



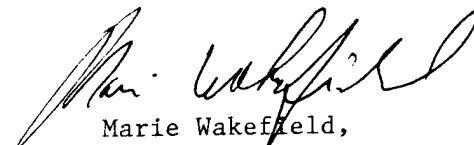


DEPARTMENT OF THE ARMY  
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS  
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Marie Wakefield,  
Librarian Engineering

## SUMMARY SHEET

BLOG #  
2840

$$\text{NATURAL GAS SAVINGS} = \underline{446} \frac{\text{MBTU}}{\text{YR}} \times \$4.00 = \$ \underline{1784}$$

$$\text{ELECTRICAL SAVINGS} = \underline{1007} \frac{\text{MBTU}}{\text{YR}} \times \$6.19 = \$ \underline{6233}$$

$$\text{TOTAL SAVINGS} = \$ \underline{8017} / \text{YR}$$

### HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
—	FID/MUX
<u>1</u>	MUX ONLY
<u>16</u>	SPACE TEMP SENSOR
<u>25</u>	DUCT TEMP SENSOR
<u>13</u>	WATER TEMP SENSOR
—	D.A. TEMP SENSOR
—	HUMIDITY SENSOR
<u>19</u>	START/STOP
<u>19</u>	STATUS RELAY
<u>6</u>	DIFF. PRESSURE (DUCT)
<u>4</u>	DIFF. PRESSURE (PIPE)
<u>4</u>	FLOW SWITCH
<u>6</u>	PRESSURE SWITCH
<u>12</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>2000</u> FT.	— 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>1000</u> FT.	— RIGID CONDUIT - 1" D.
<u>15</u>	JUNCTION BOXES
<u>112</u>	PROGRAMMING POINTS
<u>400</u> FT	— POWER WIRING

Project	FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY	Checked By	Date
		GSL	9-17-93
		Prepared By	Sheet No.
		GSL	
		Job No.	5-1
		93006101	

## BASELINE ENERGY USAGE

BLDG #

2840

HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ\text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ\text{F-DAY}) \left(2.1 \times 10^6 \frac{\text{BTU}}{\text{HR}}\right)}{(0.65) (68 - 4)^\circ\text{F}} (0.6)$$

$$\text{ENERGY} = \underline{3120 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

AUXILIARY EQUIPMENT:

FANS:  $\text{ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$

$$\text{ENERGY} = \underline{55} * 2545 * \underline{1.0} * 4369 = \underline{612 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

PUMPS:  $\text{ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$

$$\text{ENERGY} = \underline{10} * 2545 * \underline{1.0} * 4369 = \underline{111 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{3843 \times 10^6} \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS BASELINE ENERGY USAGE	Checked By	Date
		GBL	9-16-93
Project	FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY	Prepared By	Sheet No.
		GBL	B-1
		Job No.	
		93006.01	



## BASELINE ENERGY USAGE

BLDG #  
**2840**

### COOLING - BIN METHOD

<u>BIN</u>	<u>HRS/YR</u>	<u>% FULL LOAD</u>	<u>FULL LOAD BTU/HR</u>	<u>BTU/YR</u>
95/99	3	* 1.0	* 960,000	= <u>2,880,000</u>
90/94	17	* 1.0	* 960,000	= <u>16,320,000</u>
85/89	75	* 0.85	* 960,000	= <u>61,200,000</u>
80/84	185	* 0.70	* 960,000	= <u>124,320,000</u>
75/79	407	* 0.55	* 960,000	= <u>214,896,000</u>
70/74	714	* 0.40	* 960,000	= <u>274,176,000</u>
65/69	673	* 0.25	* 960,000	= <u>161,520,000</u>

TOTAL  
HRS/YR = 2074

TOTAL  $\frac{BTU}{YR}$  = 855,312,000

$$\begin{aligned} \text{TOTAL ELECTRICAL ENERGY INPUT COOLING} &= \frac{855 \times 10^6 \frac{BTU}{YR}}{2 \text{ (AVG. C.O.P.)}} \\ &= \underline{428 \times 10^6 \text{ BTU/YR (ELEC)}} \end{aligned}$$

NOTE: HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 3 A.M.

### AUXILIARIES:

$$\text{FANS: } \underline{55} \text{ HP} \times \frac{2545 \frac{BTU}{HP \cdot HR}}{1.0} \times 2074 = \underline{290 \times 10^6 \frac{BTU}{YR} \text{ (ELEC)}}$$

FOR THE HOURS FROM 5 P.M. TO 3 A.M.

$$\begin{aligned} \text{TOTAL BASELINE COOLING ENERGY} &= \underline{718 \times 10^6 \frac{BTU}{YR} \text{ (ELEC)}} \\ \text{THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS} & \\ \text{FOR IMPLEMENTING THIS ECO} & \end{aligned}$$

Title ECO-10 - EMCS ADDITIONS BASELINE COOLING ENERGY	Checked By GBL	Date 9-21-93
Project FORT CAMPBELL ENERGY SAVINGS	Prepared By GBL	Sheet No. 2-7

## PROPOSED ENERGY USAGE

BLDG #  
2840

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(2.1 \times 10^6) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 1.5 \times 10^6 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right)}{n (68 - 4)^{\circ}\text{F}} (0.6) + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) \left( \frac{\text{BASELINE HEATING ENERGY}}{\text{DAY}} \right)}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 \left( 1.5 \times 10^6 \frac{\text{BTU}}{\text{HR}} \right)}{(0.65) (64)} (0.6) + \frac{(24 - 12) (3120 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 2674 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE AUX. ENERGY} - \text{PROPOSED AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = 723 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ 65 \text{ HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACT}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 289 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)} \quad \text{TOTAL ENERGY SAVINGS} = 735 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Project	Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
		PROPOSED ENERGY USAGE	Prepared By	GBL		
		FT. CAMPBELL ENERGY SAVINGS	Job No.	92000001	Sheet No.	E-1

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 11:04:27

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 2840

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-129  
PROJECT ID. 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840

TIME 11:04:27

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 2840  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 11:04:27

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100	1000.00 LF EELEF			78	2,342	11	900	45	3,298
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION	0.40 MLF EELEF			2	70	0	21	1	92
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100	15.00 EA EELEB			10	330	1	73	4	408
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100	2.00 MLF EELEF			17	500	2	1,640	82	2,224
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100	19.00 EA EELEB			95	3,136	12	1,140	57	4,345
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100	19.00 EA EELEB			24	784	3	380	19	1,186
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100	12.00 EA EELEB			15	495	2	1,020	51	1,568
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100	16.00 EA EELEB			40	1,320	5	640	32	1,998
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100	25.00 EA EESMA			50	1,570	35	1,125	56	2,786
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100	13.00 EA EPIPA			55	1,738	4	780	39	2,561

CREW ID: ORL290

CURRENCY in DOLLARS

4-131

PROJECT ID: 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840  
1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 11:04:27

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE									
CD=3 EL 4002 DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100 SENSOR	6.00 EA EESMA			12	377	8	210	11	606
CD=3 EL 4003 PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100 SENSOR	4.00 EA EPIPA			34	1,070	3	340	17	1,429
16962 PRESSURE SWITCHES									
CD=3 EL 1001 PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100	6.00 EA EESMA			12	377	8	480	24	889
16963 FLOW SWITCHES									
CD=3 EL 1001 FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100	4.00 EA EELEB			10	330	1	760	38	1,129
CD=3 EL 1002 FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100	4.00 EA MSPFB			20	551	8	0	0	559
16991 5000 MUX									
CD=3 EL 5001 MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100	1.00 EA EELEB			5	165	1	4,720	236	5,122
16991 6000 CABINET									
CD=3 EL 6001 DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100	1.00 EA EELEB			3	83	0	350	18	450
CD=3 EL 6002 INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100	1.00 EA EELEB			3	83	0	125	6	214
16991 7000 SOFTWARE									
CD=3 EL 7001 PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100	112.00 EA EELEB			140	4,621	18	3,360	168	8,167
TOTAL DIVISION 16 ELECTRICAL				624	19,941	124	18,064	903	39,032
TOTAL FACILITY AA. ELECTRICAL				624	19,941	124	18,064	903	39,032
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				624	19,941	124	18,064	903	39,032
TOTAL BASE BID				624	19,941	124	18,064	903	39,032

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840  
2. SITEWORK /

TIME 11:04:27

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				624	19,941	124	18,064	903	39,032

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-133  
PROJECT ID: 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840

TIME 11:04:27

PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

CREW ID: ORL290

CURRENCY in DOLLARS

4-134  
PROJECT ID: 284010



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840

TIME 11:04:27

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	39,032	3,903	0	3,220	1,154	0	47,309	47309.36
BID ITEM TOTAL		1.00 EA	39,032	3,903	0	3,220	1,154	0	47,309	47309.36

CREW ID: ORL290

CURRENCY in DOLLARS

4-135  
PROJECT ID: 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840

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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	39,032	3,903	0	3,220	1,154	0	47,309	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	39,032	3,903	0	3,220	1,154	0	47,309	

CREW ID: ORL290

CURRENCY in DOLLARS

4-136  
PROJECT ID: 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 2840

TIME 11:04:27

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	47,309		47,309	47309.40
	TOTAL CURRENT CONTRACT COST			47,309	0	47,309	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			47,309	0	47,309	
	Government-Furnished Property			0		0	
	SUBTOTAL			47,309	0	47,309	
	Contingencies	10.0%		4,731	0	4,731	
	SUBTOTAL			52,040	0	52,040	
	SIOH (S&A)	5.0%		2,602	0	2,602	
	CURRENT WORKING ESTIMATE			54,642	0	54,642	
	Estimated Construction Time	365	Days				

CREW ID: ORL290

CURRENCY in DOLLARS

4-137  
 PROJECT ID: 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840

TIME 11:04:27

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	624	19,941	124	18,967	39,032	100.0%	0	39,032
	TOTAL DIRECT				624	19,941	124	18,967	39,032	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

4-138  
PROJECT ID: 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840

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CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHR%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		39,032	3,903	10.0%	0.0	3,220	7.5%	2.5%	0.0%	47,309	100.0%	47309.34
	TOTAL OVERHEAD & PROFIT			3,903	10.0%		3,220	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

4-139  
PROJECT ID: 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / PT CAMPBELL, KY  
ECO-10: BUILDING 2840

TIME 11:04:27

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	624	19,941	124	18,064	903	39,032
TOTAL DIRECT	624	19,941	124	18,064	903	39,032

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840

TIME 11:04:27

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	624	19,941	124	18,064	903	39,032
TOTAL DIRECT	624	19,941	124	18,064	903	39,032

CREW ID: ORL290

CURRENCY in DOLLARS

4-141  
PROJECT ID: 284010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840

TIME 11:04:27

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL	HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	UPB	HOURS	TOTAL	COST
EMI20 SMALL TOOLS									1.40	1.40	89	124	
TOTAL PROJECT EQUIPMENT HOURS											89	124	



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 2840

TIME 11:04:27

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTH	TKS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	525	17,033
LSHMT SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	37	1,106
LSPFI STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	62	1,804
TOTAL PROJECT MANHOURS								624	19,942

\* \* \* END OF SUMMARY REPORT \* \* \*

## SUMMARY SHEET

BLOG #  
3069

$$\text{NATURAL GAS SAVINGS} = \frac{150}{\text{YR}} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{4.00}{\text{MBTU}} = \$ \underline{600}$$

$$\text{ELECTRICAL SAVINGS} = \frac{495}{\text{YR}} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{6.19}{\text{MBTU}} = \$ \underline{3064}$$

$$\text{TOTAL SAVINGS} = \$ \underline{3664} / \text{YR}$$

### HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
—	FID/MUX
<u>1</u>	MUX ONLY
<u>8</u>	SPACE TEMP SENSOR
<u>24</u>	DUCT TEMP SENSOR
<u>4</u>	WATER TEMP SENSOR
<u>1</u>	D.A. TEMP SENSOR
—	HUMIDITY SENSOR
<u>12</u>	START/STOP
<u>12</u>	STATUS RELAY
<u>8</u>	DIFF. PRESSURE (DUCT)
<u>2</u>	DIFF. PRESSURE (PIPE)
<u>2</u>	FLOW SWITCH
<u>8</u>	PRESSURE SWITCH
<u>12</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>2000</u> FT.	— 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>1000</u> FT.	— RIGID CONDUIT - 1" D.
<u>12</u>	JUNCTION BOXES
<u>300</u> FT.	POWER WIRING
<u>93</u>	PROGRAMMING POINTS

Title ECO-10 - EMCS ADDITIONS  
SUMMARY SHEET

Checked By  
GBL

Date  
9-17-93

Project FT. CAMPBELL ENERGY SAVINGS  
OPPORTUNITY SURVEY

Prepared By  
GBL

Sheet No.

Job No. 92001-01

5-1

## BASELINE ENERGY USAGE

BLDG #

3069

HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ \text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ \text{F-DAY}) \left(720,000 \frac{\text{BTU}}{\text{HR}}\right)}{(0.45) (68 - 4)^\circ \text{F}} (0.6)$$

$$\text{ENERGY} = \underline{1069 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

AUXILIARY EQUIPMENT:

8 AHU's @ 3 HP

$$\text{FANS: ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{24} * 2545 * \underline{1.0} * 4369 = \underline{266 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

PUMPS:

$$\text{ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HTR HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{5} * 2545 * \underline{1.0} * 4369 = \underline{56 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{1391 \times 10^6} \frac{\text{BTU}}{\text{YR}}$$

Title ECO-10 - EMCS ADDITIONS BASELINE ENERGY USAGE	Checked By GBL	Date 9-16-93
Project FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY	Prepared By GBL Job No. 93056.01	Sheet No. B-1

## BASELINE ENERGY USAGE

BLDG #  
**3069**

### COOLING - BIN METHOD

<u>BIN</u>	<u>HRS/YR</u>	<u>% FULL LOAD</u>	<u>FULL LOAD BTU/Hr</u>	<u>BTU/YR</u>
95/99	3	* 1.0	* 360,000	= <u>1,080,000</u>
90/94	17	* 1.0	* 360,000	= <u>6,120,000</u>
85/89	75	* 0.85	* 360,000	= <u>22,950,000</u>
80/84	185	* 0.70	* 360,000	= <u>46,620,000</u>
75/79	407	* 0.55	* 360,000	= <u>80,586,000</u>
70/74	714	* 0.40	* 360,000	= <u>102,816,000</u>
65/69	673	* 0.25	* 360,000	= <u>60,570,000</u>

TOTAL  
HRS/YR = 2074

TOTAL BTU/YR = 320,742,000

$$\begin{aligned} \text{TOTAL ELECTRICAL ENERGY INPUT COOLING} &= \frac{320 \times 10^6 \text{ BTU}}{\text{YR}} \div 2 \left( \frac{\text{AVG.}}{\text{C.O.P.}} \right) \\ &= \underline{160 \times 10^6 \text{ BTU/YR (ELEC)}} \end{aligned}$$

NOTE: HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 8 A.M.

### AUXILIARIES:

8 FANS @ 3 HP; 1 C.W. PUMP @ 15 HP

$$\text{FANS: } 39 \text{ HP} \times 2545 \frac{\text{BTU}}{\text{HP-HR}} + 1.0 \times 2074 = \underline{206 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}}$$

FOR THE HOURS FROM 5 P.M. TO 8 A.M.

$$\begin{aligned} \text{TOTAL BASELINE COOLING ENERGY} &= \underline{366 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}} \\ \text{THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS} & \\ \text{FOR IMPLEMENTING THIS ECO} & \end{aligned}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	7-21-93
	BASELINE COOLING ENERGY	Prepared By	GBL		
	Project	Job No.	23001	Sheet No.	2-7

OPPORTUNITY STUDY

## PROPOSED ENERGY USAGE

BLDG #  
3069

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED  
HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM  
(EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(720,000) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 518,000 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right)}{72 (68 - 4)^{\circ}\text{F}} (0.6) + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \end{aligned}$$

$$= \frac{(12 \text{ HRS}) 4290 (518,000 \frac{\text{BTU}}{\text{HR}})}{(0.65) (64)} (0.6) + \frac{(24 - 12) (1069 \times 10^6)}{24}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 919 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

AUXILIARY ENERGY SAVINGS = BASELINE AUX. ENERGY - PROPOSED AUX. ENERGY

$$\text{AUX. ENERGY SAVINGS} = 322 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{FROM SHEET B-1}) - [29 \text{ HP} * 2545 * 0.6 (\text{DIV. FACTOR}) * 4369]$$

$$\text{AUX. ENERGY SAVINGS} = 129 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC}) \quad \text{TOTAL ENERGY SAVINGS} = 279 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
	PROPOSED ENERGY USAGE	Prepared By	GBL	Sheet No.	
Project	FT. CAMPBELL ENERGY SAVINGS	Job No.	92000001	Sheet No.	E-1
OPPORTUNITY SURVEY					

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 09:18:40

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 3069

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
COMPOSER Plus Copyright (C) 1985, 1988  
by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-148  
PROJECT ID: 3069

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

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DETAILED ESTIMATE	DETAIL PAGE
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AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 3069  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 09:18:46

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100	1000.00 LF EELEF			78	2,342	11	900	45	3,298
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION	0.30 MLF EELEF			2	52	0	16	1	69
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100	12.00 EA EELEB			8	264	1	58	3	326
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100	2.00 MLF EELEF			17	500	2	1,640	82	2,224
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100	12.00 EA EELEB			60	1,981	8	720	36	2,744
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100	12.00 EA EELEB			15	495	2	240	12	749
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100	12.00 EA EELEB			15	495	2	1,020	51	1,568
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100	8.00 EA EELEB			20	660	3	320	16	999
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100	24.00 EA EESMA			48	1,507	34	1,080	54	2,675
CD=3 EL 3003 OUTSIDE AIR TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	45.00	2.25	130.10
WC=1100	1.00 EA EELEB			3	83	0	45	2	130
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100	4.00 EA EPIPA			17	535	1	240	12	788

CREW ID: ORL290

CURRENCY in DOLLARS

4-150  
PROJECT ID: 306910



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 3069  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 09:18:46

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE										
CD=3 EL 4002	DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100	SENSOR	8.00 EA EESMA			16	502	11	280	14	808
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	2.00 EA EPIPA			17	535	1	170	9	715
16962 PRESSURE SWITCHES										
CD=3 EL 1001	PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100		8.00 EA EESMA			16	502	11	640	32	1,186
16963 FLOW SWITCHES										
CD=3 EL 1001	FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100		2.00 EA EELEB			5	165	1	380	19	565
CD=3 EL 1002	FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100		2.00 EA MSPFB			10	275	4	0	0	279
16991 5000 MUX										
CD=3 EL 5001	MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100		1.00 EA EELEB			5	165	1	4,720	236	5,122
16991 6000 CABINET										
CD=3 EL 6001	DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100		1.00 EA EELEB			3	83	0	350	18	450
CD=3 EL 6002	INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100		1.00 EA EELEB			3	83	0	125	6	214
16991 7000 SOFTWARE										
CD=3 EL 7001	PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100		93.00 EA EELEB			116	3,837	15	2,790	140	6,782
TOTAL DIVISION 16 ELECTRICAL					472	15,061	108	15,734	787	31,690
TOTAL FACILITY AA. ELECTRICAL					472	15,061	108	15,734	787	31,690
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					472	15,061	108	15,734	787	31,690
TOTAL BASE BID					472	15,061	108	15,734	787	31,690

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 306910

4-151

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069  
2. SITEWORK /

TIME 09:18:46

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				472	15,061	108	15,734	787	31,690

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-152  
PROJECT ID: 306910

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

PROJECT NOTES

SUMMARY PAGE 1

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PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	31,690	3,169	0	2,614	937	0	38,410	38410.43
BID ITEM TOTAL		1.00 EA	31,690	3,169	0	2,614	937	0	38,410	38410.43

CREW ID: ORL290

CURRENCY in DOLLARS

4-154  
PROJECT ID: 306910

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		31,690	3,169	0	2,614	937	0	38,410	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		31,690	3,169	0	2,614	937	0	38,410	

CREW ID: ORL290

CURRENCY in DOLLARS

4-155  
PROJECT ID: 306910

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 3069

TIME 09:18:46

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	38,410		38,410	38410.40
	TOTAL CURRENT CONTRACT COST			38,410	0	38,410	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			38,410	0	38,410	
	Government-Furnished Property			0		0	
	SUBTOTAL			38,410	0	38,410	
	Contingencies	10.0%		3,841	0	3,841	
	SUBTOTAL			42,251	0	42,251	
	SIOH (S&A)	5.0%		2,113	0	2,113	
	CURRENT WORKING ESTIMATE			44,364	0	44,364	
	Estimated Construction Time	365	Days				

CREW ID: ORL290

CURRENCY in DOLLARS

4-156  
 PROJECT ID: 306910

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	472	15,061	108	16,521	31,690 100.0%	0	31,690
	TOTAL DIRECT				472	15,061	108	16,521	31,690 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

4-157  
PROJECT ID: 306910

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		31,690	3,169	10.0%	0.0	2,614	7.5%	2.5%	0.0%	38,410	100.0%	38410.40
	TOTAL OVERHEAD & PROFIT			3,169	10.0%		2,614	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

4-158  
PROJECT ID: 306910



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	472	15,061	108	15,734	787	31,690
TOTAL DIRECT	472	15,061	108	15,734	787	31,690

CREW ID: ORL290

CURRENCY in DOLLARS

4-159  
PROJECT ID: 306910

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	472	15,061	108	15,734	787	31,690
TOTAL DIRECT	472	15,061	108	15,734	787	31,690

CREW ID: ORL290

CURRENCY in DOLLARS

4-160  
PROJECT ID: 306910

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
EMI20 SMALL TOOLS								1.40	1.40	77	108
TOTAL PROJECT EQUIPMENT HOURS										77	108

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3069

TIME 09:18:46

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	406	13,114
LSHMT	SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	40	1,195
LSPFI	STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	26	753
TOTAL PROJECT MANHOURS									472	15,062

\* \* \* END OF SUMMARY REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-162  
PROJECT ID: 306910

## SUMMARY SHEET

BLOG #

3071

$$\text{NATURAL GAS SAVINGS} = \frac{150 \text{ MBTU}}{\text{YR}} * \$ \frac{4.00}{\text{MBTU}} = \$ \underline{600}$$

$$\text{ELECTRICAL SAVINGS} = \frac{495 \text{ MBTU}}{\text{YR}} * \$ \frac{6.19}{\text{MBTU}} = \$ \underline{3064}$$

$$\text{TOTAL SAVINGS} = \$ \underline{3664} / \text{YR}$$

### HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
—	FID/MUX
<u>1</u>	MUX ONLY
<u>8</u>	SPACE TEMP SENSOR
<u>24</u>	DUCT TEMP SENSOR
<u>4</u>	WATER TEMP SENSOR
<u>1</u>	D.A. TEMP SENSOR
—	HUMIDITY SENSOR
<u>12</u>	START/STOP
<u>12</u>	STATUS RELAY
<u>8</u>	DIFF. PRESSURE (DUCT)
<u>2</u>	DIFF. PRESSURE (PIPE)
<u>2</u>	FLOW SWITCH
<u>8</u>	PRESSURE SWITCH
<u>12</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>2000</u>	FT. — 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>1000</u>	FT. — RIGID CONDUIT — 1" D.
<u>12</u>	JUNCTION BOXES
<u>300</u>	FT POWER WIRING
<u>93</u>	PROGRAMMING POINTS

Title ECO-10 - EMCS ADDITIONS

SUMMARY SHEET

Project FT. CAMPBELL ENERGY SAVINGS

OPPORTUNITY STUDY

Checked By

GBL

Prepared By

GBL

Job No.

92001-01

Date

9-17-93

Sheet No.

5-1

## BASELINE ENERGY USAGE

BLDG #

3071

HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{Q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{Q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ\text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ\text{F-DAY}) \left(720,000 \frac{\text{BTU}}{\text{HR}}\right)}{(0.45) (68 - 4)^\circ\text{F}} (0.6)$$

$$\text{ENERGY} = \underline{1069 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

AUXILIARY EQUIPMENT:

8 AHU'S @ 3 HP EACH

$$\text{FANS: ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{24} * 2545 * \underline{1.0} * 4369 = \underline{266 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

PUMPS:

$$\text{ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{5} * 2545 * \underline{1.0} * 4369 = \underline{56 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{1391 \times 10^6} \frac{\text{BTU}}{\text{YR}}$$

Title ECO-10 - EMCS ADDITIONS  
BASELINE ENERGY USAGE

Checked By GBL

Date 7-16-93

Prepared By GBL

Sheet No.

Project FT. CAMPBELL ENERGY SAVINGS  
OPPORTUNITY SURVEY

Job No. 92256 01

B-1

## BASLINE ENERGY USAGE

BLDG #  
3071

### COOLING - BIN METHOD

<u>BIN</u>	<u>HRS/YR</u>		<u>% FULL LOAD</u>	<u>FULL LOAD BTU/HR</u>	<u>BTU/YR</u>
95/99	3	*	1.0	* 360,000	= <u>1,080,000</u>
90/94	17	*	1.0	* 360,000	= <u>6,120,000</u>
85/89	75	*	0.85	* 360,000	= <u>22,950,000</u>
80/84	185	*	0.70	* 360,000	= <u>46,620,000</u>
75/79	407	*	0.55	* 360,000	= <u>80,586,000</u>
70/74	714	*	0.40	* 360,000	= <u>102,816,000</u>
65/69	673	*	0.25	* 360,000	= <u>60,570,000</u>

TOTAL  
HRS/YR = 2074

TOTAL BTU/YR = 320,742,000

$$\begin{aligned} \text{TOTAL ELECTRICAL ENERGY INPUT COOLING} &= \frac{320 \times 10^6 \text{ BTU}}{\text{YR}} \div 2 \text{ (AVG. C.O.P.)} \\ &= \underline{160 \times 10^6 \text{ BTU/YR (ELEC)}} \end{aligned}$$

NOTE: HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 3 A.M.

### AUXILIARIES:

8 FANS @ 3 HP EACH; 1 C.W. PUMP @ 15

$$\text{FANS: } \underline{39} \text{ HP} \pm 2545 \frac{\text{BTU}}{\text{HP HR}} \times 1.0 \times 2074 = \underline{206 \times 10^6 \frac{\text{BTU}}{\text{YR}}} \text{ (ELEC)}$$

FOR THE HOURS FROM 5 P.M. TO 3 A.M.

$$\begin{aligned} \text{TOTAL BASELINE COOLING ENERGY} &= \underline{366 \times 10^6 \frac{\text{BTU}}{\text{YR}}} \text{ (ELEC)} \\ \text{THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS} & \\ \text{FOR IMPLEMENTING THIS ECO} & \end{aligned}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GSL	Date	
	BASELINE COOLING ENERGY	Prepared By	GSL	9-21-93	
	Project	Job No.		Sheet No.	
	FORT CAMPBELL ENERGY SAVINGS			2-7	

## PROPOSED ENERGY USAGE

BLDG #  
3071

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED  
HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM  
(EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(720,000) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 518,000 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{DAY}} \right)}{n (68 - 4)^{\circ}\text{F}} (0.6) + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 (518,000 \frac{\text{BTU}}{\text{HR}})}{(0.65) (64)} (0.6) + \frac{(24 - 12) (1069 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 919 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

AUXILIARY ENERGY SAVINGS = BASELINE AUX. ENERGY - PROPOSED AUX. ENERGY

$$\text{AUX. ENRG. SAVINGS} = 322 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ 29 \text{ HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACT}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 129 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC}) \quad \text{TOTAL ENERGY SAVINGS} = 279 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
	PROPOSED ENERGY USAGE	Prepared By	GBL	Sheet No.	
Project	FT. CAMPBELL ENERGY SAVINGS	Job No.	02-11-1	F-1	



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 09:53:58

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 3071

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-167  
PROJECT ID: 307110

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

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AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS H-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071  
1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 09:53:58

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100	1000.00 LF EELEF			78	2,342	11	900	45	3,298
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION	0.30 MLF EELEF			2	52	0	16	1	69
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100	12.00 EA EELEB			8	264	1	58	3	326
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100	2.00 MLF EELEF			17	500	2	1,640	82	2,224
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100	12.00 EA EELEB			60	1,981	8	720	36	2,744
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100	12.00 EA EELEB			15	495	2	240	12	749
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100	12.00 EA EELEB			15	495	2	1,020	51	1,568
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100	8.00 EA EELEB			20	660	3	320	16	999
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100	24.00 EA EESMA			48	1,507	34	1,080	54	2,675
CD=3 EL 3003 OUTSIDE AIR TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	45.00	2.25	130.10
WC=1100	1.00 EA EELEB			3	83	0	45	2	130
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100	4.00 EA EPIPA			17	535	1	240	12	788

CREW ID: ORL290

CURRENCY in DOLLARS

4-169  
PROJECT ID: 307110

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 3071  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 09:53:58

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE									
CD=3 EL 4002 DUCT DIFFERENTIAL PRESSURE	***	UNIT COSTS: ***		2.00	62.79	1.40	35.00	1.75	100.94
WC=1100 SENSOR	8.00	EA EESMA		16	502	11	280	14	808
CD=3 EL 4003 PUMP DIFFERENTIAL PRESSURE	***	UNIT COSTS: ***		8.50	267.42	0.65	85.00	4.25	357.31
WC=1100 SENSOR	2.00	EA EPIPA		17	535	1	170	9	715
16962 PRESSURE SWITCHES									
CD=3 EL 1001 PRESSURE SWITCH	***	UNIT COSTS: ***		2.00	62.79	1.40	80.00	4.00	148.19
WC=1100	8.00	EA EESMA		16	502	11	640	32	1,186
16963 FLOW SWITCHES									
CD=3 EL 1001 FLOW SWITCH	***	UNIT COSTS: ***		2.50	82.53	0.32	190.00	9.50	282.35
WC=1100	2.00	EA EELEB		5	165	1	380	19	565
CD=3 EL 1002 FLOW SWITCH	***	UNIT COSTS: ***		5.00	137.72	2.02	0.00	0.00	139.73
WC=1100	2.00	EA MSPFB		10	275	4	0	0	279
16991 5000 MUX									
CD=3 EL 5001 MUX	***	UNIT COSTS: ***		5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100	1.00	EA EELEB		5	165	1	4,720	236	5,122
16991 6000 CABINET									
CD=3 EL 6001 DATA TERMINAL CABINET	***	UNIT COSTS: ***		2.50	82.53	0.32	350.00	17.50	450.35
WC=1100	1.00	EA EELEB		3	83	0	350	18	450
CD=3 EL 6002 INSTRUMENT SHELTER	***	UNIT COSTS: ***		2.50	82.53	0.32	125.00	6.25	214.10
WC=1100	1.00	EA EELEB		3	83	0	125	6	214
16991 7000 SOFTWARE									
CD=3 EL 7001 PROGRAMMING POINTS FOR EMCS	***	UNIT COSTS: ***		1.25	41.26	0.16	30.00	1.50	72.92
WC=1100	93.00	EA EELEB		116	3,837	15	2,790	140	6,782
TOTAL DIVISION 16 ELECTRICAL	472				15,061	108	15,734	787	31,690
TOTAL FACILITY AA. ELECTRICAL	472				15,061	108	15,734	787	31,690
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE	472				15,061	108	15,734	787	31,690
TOTAL BASE BID	472				15,061	108	15,734	787	31,690

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 307110

4-170

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071  
2. SITEWORK /

TIME 09:53:58

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				472	15,061	108	15,734	787	31,690

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-171  
PROJECT ID: 307110

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	31,690	3,169	0	2,614	937	0	38,410	38410.43
BID ITEM TOTAL		1.00 EA	31,690	3,169	0	2,614	937	0	38,410	38410.43

CREW ID: ORL290

CURRENCY in DOLLARS

4-173  
PROJECT ID: 307110

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	31,690	3,169	0	2,614	937	0	38,410	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	31,690	3,169	0	2,614	937	0	38,410	

CREW ID: ORL290

CURRENCY in DOLLARS

4-174  
PROJECT ID: 307110



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
	1. BUILDING TO THE 5 FOOT LINE	1.00 EA	38,410		38,410	38410.40
	TOTAL CURRENT CONTRACT COST		38,410	0	38,410	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		38,410	0	38,410	
	Government-Furnished Property		0		0	
	SUBTOTAL		38,410	0	38,410	
	Contingencies	10.0%	3,841	0	3,841	
	SUBTOTAL		42,251	0	42,251	
	SIOH (S&A)	5.0%	2,113	0	2,113	
	CURRENT WORKING ESTIMATE		44,364	0	44,364	
	Estimated Construction Time	365 Days				

CREW ID: ORL290

CURRENCY in DOLLARS

4-175  
PROJECT ID: 307110

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	472	15,061	108	16,521	31,690	100.0%		0	31,690
	TOTAL DIRECT				472	15,061	108	16,521	31,690	100.0%			

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOFC%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHR%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		31,690	3,169	10.0%	0.0		2,614	7.5%	2.5%	0.0%		38,410	100.0%		38410.40
	TOTAL OVERHEAD & PROFIT			3,169	10.0%			2,614	7.5%							

CREW ID: ORL290

CURRENCY in DOLLARS

4-177  
PROJECT ID: 307110

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	472	15,061	108	15,734	787	31,690
TOTAL DIRECT	472	15,061	108	15,734	787	31,690

CREW ID: ORL290

CURRENCY in DOLLARS

4-178

PROJECT ID: 307110

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	472	15,061	108	15,734	787	31,690
TOTAL DIRECT	472	15,061	108	15,734	787	31,690

CREW ID: ORL290

CURRENCY in DOLLARS

4-179

PROJECT ID: 307110

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
EMI20 SMALL TOOLS								1.40	1.40	77	108
TOTAL PROJECT EQUIPMENT HOURS										77	108

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3071

TIME 09:53:58

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	406	13,114
LSEMT	SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	40	1,195
LSPFI	STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	26	753
									472	15,062
TOTAL PROJECT MANHOURS										

\* \* \* END OF SUMMARY REPORT \* \* \*

## SUMMARY SHEET

BLOG #  
**3934**

$$\text{NATURAL GAS SAVINGS} = \frac{100}{\text{YR}} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{4.00}{\text{MBTU}} = \$ \underline{400}$$

$$\text{ELECTRICAL SAVINGS} = \frac{263}{\text{YR}} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{6.19}{\text{MBTU}} = \$ \underline{1630}$$

$$\text{TOTAL SAVINGS} = \$ \underline{2030} / \text{YR}$$

### HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
<u>1</u>	FID/MUX
<u>1</u>	MUX ONLY
<u>2</u>	SPACE TEMP SENSOR
<u>4</u>	DUCT TEMP SENSOR
<u>2</u>	WATER TEMP SENSOR
<u>1</u>	D.A. TEMP SENSOR
<u>1</u>	HUMIDITY SENSOR
<u>4</u>	START/STOP
<u>4</u>	STATUS RELAY
<u>2</u>	DIFF. PRESSURE (DUCT)
<u>1</u>	DIFF. PRESSURE (PIPE)
<u>1</u>	FLOW SWITCH
<u>2</u>	PRESSURE SWITCH
<u>3</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>800</u>	FT. - 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>400</u>	FT. - RIGID CONDUIT - 1" D.
<u>5</u>	JUNCTION BOXES
<u>27</u>	PROGRAMMING POINTS
<u>100</u>	FT. POWER WIRING

Title	ECO-10 - EMCS ADDITIONS	Checked By	GSL	Date	9-17-93
	SUMMARY SHEET	Prepared By	GSL	Sheet No.	5-1
	Project	Job No.	92000.01		
	FT. CAMPBELL ENERGY SAVINGS				
	OPPORTUNITY SURVEY				



## BASELINE ENERGY USAGE

BLDG #

3934

HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{Q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{Q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ\text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ\text{F-DAY}) \left(480,000 \frac{\text{BTU}}{\text{HR}}\right)}{(0.65) (68 - 4)^\circ\text{F}} (0.6)$$

$$\text{ENERGY} = 713 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

AUXILIARY EQUIPMENT:

1 S.F @ 15; 1 R.F @ 5; 1 S.F @ 1 HP

FANS: ENERGY = FAN HP \* 2545  $\frac{\text{BTU}}{\text{HR} \cdot \text{HP}}$  \* DIVERSITY FACTOR \*  $\frac{\text{HEATING HRS}}{\text{YR}}$

$$\text{ENERGY} = 21 * 2545 * 1.0 * 4369 = 234 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC})$$

PUMPS:

ENERGY = PUMP HP \* 2545  $\frac{\text{BTU}}{\text{HR} \cdot \text{HP}}$  \* DIVERSITY FACTOR \*  $\frac{\text{HRS}}{\text{YR}}$

$$\text{ENERGY} = \frac{3}{4} * 2545 * 1.0 * 4369 = 8 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC})$$

$$\text{TOTAL BASELINE HEATING ENERGY} = 955 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Project	Title ECO-10 - EMCS ADDITIONS BASELINE ENERGY USAGE FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY	Checked By GBL	Date 9-16-93
		Prepared By GBL	Sheet No. B-1
		Job No. 92-06-01	

## BASELINE ENERGY USAGE

BLDG #  
3934

### COOLING - BIN METHOD

<u>BIN</u>	<u>HRS/YR</u>		<u>% FULL LOAD</u>	<u>FULL LOAD BTU/Hr</u>	<u>BTU YR</u>
95/99	3	*	1.0	* 120,000	= <u>360,000</u>
90/94	17	*	1.0	* 120,000	= <u>2,040,000</u>
85/89	75	*	0.85	* 120,000	= <u>7,650,000</u>
80/84	185	*	0.70	* 120,000	= <u>15,540,000</u>
75/79	407	*	0.55	* 120,000	= <u>26,862,000</u>
70/74	714	*	0.40	* 120,000	= <u>34,272,000</u>
65/69	673	*	0.25	* 120,000	= <u>20,190,000</u>

TOTAL  
HRS/YR = 2074

TOTAL BTU/YR = 106,914,000

$$\text{TOTAL ELECTRICAL ENERGY INPUT COOLING} = \frac{106.9 \times 10^6 \text{ BTU}}{\text{YR}} \div 2 \left( \frac{\text{AUG.}}{\text{C.O.P.}} \right)$$

$$= \underline{54 \times 10^6 \text{ BTU/YR (ELEC)}}$$

NOTE : HRS/YR INDICATE THE TOTAL ANNUAL OCCURENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 8 A.M.

### AUXILIARIES :

$$\text{FANS : } \underline{21} \text{ HP} \times 2545 \frac{\text{BTU}}{\text{HP HRS}} \times 1.0 \times 2074 = \underline{111 \times 10^6 \text{ BTU/YR (ELEC)}}$$

FOR THE HOURS FROM 5 P.M. TO 8 A.M.:

$$\text{TOTAL BASELINE COOLING ENERGY} = \underline{165 \times 10^6 \text{ BTU/YR (ELEC)}}$$

THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS  
FOR IMPLEMENTING THIS ECO

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date
	BASELINE COOLING ENERGY	Prepared By	GBL	
Project	PORT CAMPBELL ENERGY SAVINGS	Job No.	22-001	Sheet No.
				2-7

## PROPOSED ENERGY USAGE

BLDG #  
3934

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED  
HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM  
(EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(480,000) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 345,000 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right)}{24 \frac{\text{HR}}{\text{DAY}}} (0.6) + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 \left( 345,000 \frac{\text{BTU}}{\text{HR}} \right)}{(0.65) (64)} (0.6) + \frac{(24 - 12) (713 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 613 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE AUX. ENERGY} - \text{PROPOSED AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = 242 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ 21 \frac{3}{4} \text{ HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACTIL}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 97 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC}) \quad \text{TOTAL ENERGY SAVINGS} = 197 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
	PROPOSED ENERGY USAGE	Prepared By	GBL	Sheet No.	
Project	FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY	Job No.	92000001		E-1

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 10:09:47

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 3934

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-186  
PROJECT ID: 393410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

TIME 10:09:47

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DETAILED ESTIMATE

DETAIL PAGE

1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 3934  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 10:09:47

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

## DIVISION 16 ELECTRICAL

QUANTITY UOM CREW MANHR LABOR EQUIPMENT MATERIAL SALESTX DIRECT \$

## 16050 BASIC MATERIALS AND METHODS

## 16111 1100 RIGID GALVANIZED STEEL CONDUIT

CD=4 EL 1121 1 IN CONDUIT W/COUPLING  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 0.08 2.34 0.01 0.90 0.05 3.30  
 400.00 LF EELEF 31 937 4 360 18 1,319

## 16120 1200 SINGLE STRANDED CONDUCTOR

CD=4 EL 1211 NO. 12 AWG - TYPE THHN  
 WC=1100 INSULATION

\*\*\* UNIT COSTS: \*\*\* 5.78 174.30 0.78 52.98 2.65 230.71  
 0.10 MLF EELEF 1 17 0 5 0 23

## 16130 1200 NEMA 1 SCREW COVER ENCL

CD=4 EL 1202 6X6X4 NEMA 1  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 0.67 22.01 0.09 4.87 0.24 27.21  
 5.00 EA EELEB 3 110 0 24 1 136

## 16900 CONTROLS AND INSTRUMENTATION

## 16920 2000 CONTROL CABLE

CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 8.28 249.82 1.12 820.00 41.00 1111.94  
 0.80 MLF EELEF 7 200 1 656 33 890

## 16920 3000 CONTROL SWITCH

CD=3 EL 3001 START/STOP  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 5.00 165.05 0.65 60.00 3.00 228.70  
 4.00 EA EELEB 20 660 3 240 12 915

## 16920 4000 RELAY

CD=3 EL 4001 STATUS RELAY  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 1.25 41.26 0.16 20.00 1.00 62.42  
 4.00 EA EELEB 5 165 1 80 4 250

CD=3 EL 4002 CURRENT RELAY  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 1.25 41.26 0.16 85.00 4.25 130.67  
 3.00 EA EELEB 4 124 0 255 13 392

## 16961 3000 TEMPERATURE

CD=3 EL 3001 SPACE TEMPERATURE SENSOR  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 2.50 82.53 0.32 40.00 2.00 124.85  
 2.00 EA EELEB 5 165 1 80 4 250

CD=3 EL 3002 DUCT TEMPERATURE SENSOR  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 2.00 62.79 1.40 45.00 2.25 111.44  
 4.00 EA EESMA 8 251 6 180 9 446

CD=3 EL 3003 OUTSIDE AIR TEMPERATURE SENSOR  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 2.50 82.53 0.32 45.00 2.25 130.10  
 1.00 EA EELEB 3 83 0 45 2 130

CD=3 EL 3004 PIPE TEMPERATURE SENSOR  
 WC=1100

\*\*\* UNIT COSTS: \*\*\* 4.25 133.71 0.32 60.00 3.00 197.03  
 2.00 EA EPIPA 9 267 1 120 6 394

CREW ID: ORL290

CURRENCY in DOLLARS

4-188

PROJECT ID: 393410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 3934  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 10:09:47

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE										
CD=3 EL 4002	DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100	SENSOR	2.00 EA EESMA		4	126		3	70	4	202
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	1.00 EA EPIPA		9	267		1	85	4	357
16961 5000 HUMIDITY										
CD=3 EL 5001	SPACE HUMIDITY SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	85.00	4.25	172.10
WC=1100		1.00 EA EELEB		3	83		0	85	4	172
16962 PRESSURE SWITCHES										
CD=3 EL 1001	PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100		2.00 EA EESMA		4	126		3	160	8	296
16963 FLOW SWITCHES										
CD=3 EL 1001	FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100		1.00 EA EELEB		3	83		0	190	10	282
CD=3 EL 1002	FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100		1.00 EA MSPFB		5	138		2	0	0	140
16991 5000 MUX										
CD=3 EL 5001	MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100		1.00 EA EELEB		5	165		1	4,720	236	5,122
16991 6000 CABINET										
CD=3 EL 6001	DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100		1.00 EA EELEB		3	83		0	350	18	450
CD=3 EL 6002	INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100		1.00 EA EELEB		3	83		0	125	6	214
16991 7000 SOFTWARE										
CD=3 EL 7001	PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100		27.00 EA EELEB		34	1,114		4	810	41	1,969
TOTAL DIVISION 16 ELECTRICAL					165	5,245	31	8,641	432	14,349
TOTAL FACILITY AA. ELECTRICAL					165	5,245	31	8,641	432	14,349

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 393410

4-189

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934  
1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 10:09:47

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE	165				5,245	31	8,641	432	14,349
TOTAL BASE BID	165				5,245	31	8,641	432	14,349
TOTAL ADDITIVE	0				0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY	165				5,245	31	8,641	432	14,349

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-190  
PROJECT ID: 393410



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

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PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	14,349	1,435	0	1,184	424	0	17,391	17391.47
BID ITEM TOTAL		1.00 EA	14,349	1,435	0	1,184	424	0	17,391	17391.47

CREW ID: ORL290

CURRENCY in DOLLARS

4-192  
PROJECT ID: 393410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR	FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		14,349	1,435	0	1,184	424	0		17,391	
TOTAL ADDITIVE		0	0	0	0	0	0		0	
TOTAL INCL ADD		14,349	1,435	0	1,184	424	0		17,391	

CREW ID: ORL290

CURRENCY in DOLLARS

4-193  
PROJECT ID: 393410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

TIME 10:09:47

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00 EA	17,392		17,392	17391.50
	TOTAL CURRENT CONTRACT COST		17,392	0	17,392	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		17,392	0	17,392	
	Government-Furnished Property		0		0	
	SUBTOTAL		17,392	0	17,392	
	Contingencies	10.0%	1,739	0	1,739	
	SUBTOTAL		19,131	0	19,131	
	SIOH (S&A)	5.0%	957	0	957	
	CURRENT WORKING ESTIMATE		20,087	0	20,087	
	Estimated Construction Time	365 Days				

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

TIME 10:09:47

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	** TOTAL DIRECT **	SUBCON	W/OH&P	SUBTOTAL
									AMOUNT PCT			
AA	GENERAL/PRIME		1.00	EA	165	5,245	31	9,073	14,349 100.0%	0		14,349
	TOTAL DIRECT				165	5,245	31	9,073	14,349 100.0%			

CREW ID: ORL290

CURRENCY in DOLLARS

4-195  
PROJECT ID: 393410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

TIME 10:09:47

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

----- *** OVERHEAD *** -----			**** PROFIT ****			----- ***** TOTAL CONTRACT *****								
ID	CONTRACTOR	PM	SUBTOTAL	AMOUNT	PCT	HOFC%	AMOUNT	PCT	BOND%	OTHR%	AMOUNT	PCT	UNIT	COST
AA	GENERAL/PRIME		14,349	1,435	10.0%	0.0	1,184	7.5%	2.5%	0.0%	17,391	100.0%	17391.44	
	TOTAL OVERHEAD & PROFIT			1,435	10.0%		1,184	7.5%						

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

TIME 10:09:47

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	165	5,245	31	8,641	432	14,349
TOTAL DIRECT	165	5,245	31	8,641	432	14,349

CREW ID: ORL290

CURRENCY in DOLLARS

4-197

PROJECT ID: 393410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

TIME 10:09:47

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	165	5,245	31	8,641	432	14,349
TOTAL DIRECT	165	5,245	31	8,641	432	14,349

CREW ID: ORL290

CURRENCY in DOLLARS

4-198  
PROJECT ID: 393410



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

TIME 10:09:47

EQUIPMENT SUMMARY

SUMMARY PAGE 9

----- *** BOOK VALUE *** ADJ FACTOR ADJUSTD BOOK OP -- HRLY --- UPB **** TOTAL ****											
EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
EMI20 SMALL TOOLS								1.40	1.40	22	31
										-----	-----
TOTAL PROJECT EQUIPMENT HOURS										22	31

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 3934

TIME 10:09:47

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	144	4,629
LSHMT SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	8	239
LSPFI STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	13	376
TOTAL PROJECT MANHOURS								165	5,244

\* \* \* END OF SUMMARY REPORT \* \* \*

## SUMMARY SHEET

BLOG #  
5380

$$\text{NATURAL GAS SAVINGS} = \frac{223 \text{ MBTU}}{\text{YR}} * \$4.00 = \$892$$

$$\text{ELECTRICAL SAVINGS} = \frac{643 \text{ MBTU}}{\text{YR}} * \$6.19 = \$3980$$

$$\text{TOTAL SAVINGS} = \$4872 / \text{YR}$$

### HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
<u>1</u>	FID/MUX
<u>4</u>	MUX ONLY
<u>12</u>	SPACE TEMP SENSOR
<u>4</u>	DUCT TEMP SENSOR
<u>1</u>	WATER TEMP SENSOR
<u>3</u>	D.A. TEMP SENSOR
<u>8</u>	HUMIDITY SENSOR
<u>8</u>	START/STOP
<u>4</u>	STATUS RELAY
<u>2</u>	DIFF. PRESSURE (DUCT)
<u>4</u>	DIFF. PRESSURE (PIPE)
<u>2</u>	FLOW SWITCH
<u>2</u>	PRESSURE SWITCH
<u>6</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
2000 FT.	- 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
1000 FT.	- RIGID CONDUIT - 1" D.
10	JUNCTION BOXES
58	PROGRAMMING POINTS
400 FT	- POWER WIRING

Title ECO-10 - EMCS ADDITIONS  
SUMMARY SHEET

Checked By  
GBL

Date  
9-17-93

Project FT. CAMPBELL ENERGY SAVINGS  
OPPORTUNITY SURVEY

Prepared By  
GBL

Sheet No.

Job No. 92001 01

5-1

## BASELINE ENERGY USAGE

BLDG #

5380

HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{Q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{Q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ\text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ\text{F-DAY}) \left(1.2 \times 10^6 \frac{\text{BTU}}{\text{HR}}\right)}{(0.65) (68 - 4)^\circ\text{F}} (0.6)$$

$$\text{ENERGY} = \underline{1782 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

AUXILIARY EQUIPMENT:

2 @ 15 HP, 1 @ 5,

$$\text{FANS: ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{40} * 2545 * \underline{1.0} * 4369 = \underline{445 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

PUMPS:

$$\text{ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{Htg HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{3} * 2545 * 1.0 * 4369 = \underline{33 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{2260 \times 10^6} \frac{\text{BTU}}{\text{YR}}$$

Title ECO-10 - EMCS ADDITIONS  
BASELINE ENERGY USAGE

Checked By GBL

Date 9-16-93

Prepared By GBL

Sheet No.

Project FT. CAMPBELL ENERGY SAVINGS  
OPPORTUNITY SURVEY

Job No. 93206.01

B-1

## BASELINE ENERGY USAGE

BLDG #  
5380

### COOLING - BIN METHOD

<u>BIN</u>	<u>HRS/YR</u>	<u>% FULL LOAD</u>	<u>FULL LOAD BTU/Hr</u>	<u>BTU/YR</u>
95/99	3	* 1.0	* 480,000	= <u>1,440,000</u>
90/94	17	* 1.0	* 480,000	= <u>8,160,000</u>
85/89	75	* 0.85	* 480,000	= <u>30,600,000</u>
80/84	185	* 0.70	* 480,000	= <u>62,160,000</u>
75/79	407	* 0.55	* 480,000	= <u>107,448,000</u>
70/74	714	* 0.40	* 480,000	= <u>137,088,000</u>
65/69	673	* 0.25	* 480,000	= <u>80,760,000</u>

TOTAL  
HRS/YR = 2074

TOTAL  $\frac{BTU}{YR} = 427,656,000$

$$\begin{aligned} \text{TOTAL ELECTRICAL ENERGY INPUT COOLING} &= \frac{428 \times 10^6 \text{ BTU}}{\text{YR}} \div 2 \text{ (AVG. C.O.P.)} \\ &= \underline{214 \times 10^6 \text{ BTU/YR (ELEC)}} \end{aligned}$$

NOTE : HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 8 A.M.

### AUXILIARIES :

40 HP IN FANS, 5 HP C.W. PUMP

$$\begin{aligned} \text{FANS : } 45 \text{ HP} &\times 2545 \frac{\text{BTU}}{\text{HP HR}} \times 1.0 \times 2074 = \underline{238 \times 10^8 \frac{\text{BTU}}{\text{YR}}} \text{ (ELEC)} \\ \text{\& PUMPS} \end{aligned}$$

FOR THE HOURS FROM 5 P.M. TO 8 A.M.

$$\begin{aligned} \text{TOTAL BASELINE COOLING ENERGY} &= \underline{452 \times 10^6 \frac{\text{BTU}}{\text{YR}}} \text{ (ELEC)} \\ \text{THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS} & \\ \text{FOR IMPLEMENTING THIS ECO} & \end{aligned}$$

Project	ECO-10 - EMCS ADDITIONS BASELINE COOLING ENERGY FORT CAMPBELL ENERGY SAVINGS	Checked By	GBL	Date	9-21-93
		Prepared By	GBL	Sheet No.	2-7
		Job No.	23-11-11		

## PROPOSED ENERGY USAGE

BLDG #  
5380

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(1.2 \times 10^6) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 0.9 \times 10^6 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right) (0.6)}{24 (68 - 4)^{\circ}\text{F}} + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 \left( 0.9 \times 10^6 \frac{\text{BTU}}{\text{HR}} \right) (0.6)}{(0.65) (64)} + \frac{(24 - 12) (1782 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 1559 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE AUX. ENERGY} - \text{PROPOSED AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = 478 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ 43 \text{ HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACT}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 191 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)} \quad \text{TOTAL ENERGY SAVINGS} = 414 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	4-204
	PROPOSED ENERGY USAGE	Prepared By	GBL	9-16-93	
	Project	Job No.	92000001	Sheet No.	
FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY				F-1	

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 12:06:48

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 5380

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-205  
PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380  
1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:06:48

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100	1000.00 LF EELEF			78	2,342	11	900	45	3,298
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION	0.40 MLF EELEF			2	70	0	21	1	92
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100	10.00 EA EELEB			7	220	1	49	2	272
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100	2.00 MLF EELEF			17	500	2	1,640	82	2,224
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100	8.00 EA EELEB			40	1,320	5	480	24	1,830
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100	8.00 EA EELEB			10	330	1	160	8	499
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100	6.00 EA EELEB			8	248	1	510	26	784
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100	4.00 EA EELEB			10	330	1	160	8	499
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100	12.00 EA EESMA			24	753	17	540	27	1,337
CD=3 EL 3003 OUTSIDE AIR TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	45.00	2.25	130.10
WC=1100	1.00 EA EELEB			3	83	0	45	2	130
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100	4.00 EA EPIPA			17	535	1	240	12	788

CREW ID: ORL290

CURRENCY in DOLLARS

4-207  
PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 5380  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:06:48

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE										
CD=3 EL 4002	DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100	SENSOR	4.00 EA EESMA		8	251	6	140	7		404
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	2.00 EA EPIPA		17	535	1	170	9		715
16961 5000 HUMIDITY										
CD=3 EL 5001	SPACE HUMIDITY SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	85.00	4.25	172.10
WC=1100		3.00 EA EELEB		8	248	1	255	13		516
16962 PRESSURE SWITCHES										
CD=3 EL 1001	PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100		2.00 EA EESMA		4	126	3	160	8		296
16963 FLOW SWITCHES										
CD=3 EL 1001	FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100		4.00 EA EELEB		10	330	1	760	38		1,129
CD=3 EL 1002	FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100		4.00 EA MSPFB		20	551	8	0	0		559
16991 5000 MUX										
CD=3 EL 5001	MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100		1.00 EA EELEB		5	165	1	4,720	236		5,122
16991 6000 CABINET										
CD=3 EL 6001	DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100		1.00 EA EELEB		3	83	0	350	18		450
CD=3 EL 6002	INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100		1.00 EA EELEB		3	83	0	125	6		214
16991 7000 SOFTWARE										
CD=3 EL 7001	PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100		58.00 EA EELEB		73	2,393	9	1,740	87		4,230
TOTAL DIVISION 16 ELECTRICAL					363	11,494	72	13,165	658	25,389
TOTAL FACILITY AA. ELECTRICAL					363	11,494	72	13,165	658	25,389

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 538010

4-208

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380  
1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:06:48

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE	363			11,494		72	13,165	658	25,389
TOTAL BASE BID	363			11,494		72	13,165	658	25,389
TOTAL ADDITIVE	0			0		0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY	363			11,494		72	13,165	658	25,389

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-209

PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

CREW ID: ORL290

CURRENCY in DOLLARS

4-210  
PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	25,389	2,539	0	2,095	751	0	30,773	30772.82
BID ITEM TOTAL		1.00 EA	25,389	2,539	0	2,095	751	0	30,773	30772.82

CREW ID: ORL290

CURRENCY in DOLLARS

4-211

PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	25,389	2,539	0	2,095	751	0	30,773	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	25,389	2,539	0	2,095	751	0	30,773	

CREW ID: ORL290

CURRENCY in DOLLARS

4-212  
PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	30,773		30,773	30772.80
	TOTAL CURRENT CONTRACT COST			30,773	0	30,773	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			30,773	0	30,773	
	Government-Furnished Property			0		0	
	SUBTOTAL			30,773	0	30,773	
	Contingencies	10.0%		3,077	0	3,077	
	SUBTOTAL			33,850	0	33,850	
	SIOH (S&A)	5.0%		1,693	0	1,693	
	CURRENT WORKING ESTIMATE			35,543	0	35,543	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

4-213

PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	363	11,494	72	13,823	25,389 100.0%	0	25,389
	TOTAL DIRECT				363	11,494	72	13,823	25,389 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

4-214  
PROJECT ID: 538010



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOFC%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		25,389	2,539	10.0%	0.0		2,095	7.5%	2.5%	0.0%		30,773	100.0%		30772.82
	TOTAL OVERHEAD & PROFIT			2,539	10.0%			2,095	7.5%							

CREW ID: ORL290

CURRENCY in DOLLARS

4-215  
PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	363	11,494	72	13,165	658	25,389
TOTAL DIRECT	363	11,494	72	13,165	658	25,389

CREW ID: ORL290

CURRENCY in DOLLARS

4-216  
PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	363	11,494	72	13,165	658	25,389
TOTAL DIRECT	363	11,494	72	13,165	658	25,389

CREW ID: ORL290

CURRENCY in DOLLARS

4-217  
PROJECT ID: 538010

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

EQUIPMENT SUMMARY

SUMMARY PAGE 9

----- *** BOOK VALUE ***		ADJ FACTOR		ADJUSTD		BOOK OP --		HRLY ---		UPB		**** TOTAL ****	
EQUIP	DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST	
EMI20	SMALL TOOLS								1.40	1.40	51	72	
TOTAL PROJECT EQUIPMENT HOURS											51	72	

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 5380

TIME 12:06:48

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	-- UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	309	9,930
LSHMT	SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	18	538
LSPFI	STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	36	1,028
TOTAL PROJECT MANHOURS									363	11,496

\* \* \* END OF SUMMARY REPORT \* \* \*

## SUMMARY SHEET

BLOG #

6627

$$\text{NATURAL GAS SAVINGS} = \frac{379.1 \text{ MBTU}}{\text{YR}} \times \$ \frac{4.00}{\text{MBTU}} = \$ 151.6$$

$$\text{ELECTRICAL SAVINGS} = \frac{1721 \text{ MBTU}}{\text{YR}} \times \$ \frac{6.19}{\text{MBTU}} = \$ 1065$$

$$\text{TOTAL SAVINGS} = \$ 2580 / \text{YR}$$

## HARDWARE REQUIRED:

QUANTITY	ITEM
<u>1</u>	FID/MUX
<u>1</u>	MUX ONLY
<u>2</u>	SPACE TEMP SENSOR
<u>6</u>	DUCT TEMP SENSOR
<u>2</u>	WATER TEMP SENSOR
<u>1</u>	D.A. TEMP SENSOR
<u>1</u>	HUMIDITY SENSOR
<u>4</u>	START/STOP
<u>4</u>	STATUS RELAY
<u>2</u>	DIFF. PRESSURE (DUCT)
<u>1</u>	DIFF. PRESSURE (PIPE)
<u>1</u>	FLOW SWITCH
<u>2</u>	PRESSURE SWITCH
<u>2</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>800</u>	FT. CONTROL CABLE
<u>400</u>	FT. 1" RIGID CONDUIT
<u>5</u>	JUNCTION BOX
<u>100</u>	FT. POWER WIRING
<u>26</u>	PROGRAMMING POINTS

Title ECO-10 - EMCS ADDITIONS

SUMMARY SHEET

Project FT. CAMPBELL ENERGY SAVINGS

ADDON TULITY SURVEY

Checked By

GBL

Prepared By

GBL

Job No.

92-201-01

Date

9-17-93

Sheet No.

5-1

## BASELINE ENERGY USAGE

BLDG #  
6627

HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY  
 $\dot{q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR  
 $\eta$  = HEATING SYSTEM EFFICIENCY  
 $\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ\text{F}$   
 $C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ\text{F-DAY}) \left(1.8 \times 10^6 \frac{\text{BTU}}{\text{HR}}\right)}{(0.65) (68 - 4)^\circ\text{F}} (0.6)$$

$$\text{ENERGY} = \underline{2673 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

AUXILIARY EQUIPMENT:

FANS:  $\text{ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$   
 $\text{ENERGY} = \underline{2 @ 10 \text{ each}} * 2545 * \underline{0.5} * 4369 = \underline{111 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$

PUMPS:  $\text{ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{Htg HRS}}{\text{YR}}$   
 $\text{ENERGY} = \underline{1 @ 2} * 2545 * \underline{1.0} * 4369 = \underline{22.2 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{2806 \times 10^6} \frac{\text{BTU}}{\text{YR}}$$

NOTE: DIVERSITY FACTOR OF 0.5 ASSUMES FAN RUNS 1/2 OF TOTAL Htg. HOURS DUE TO TIME

Title	ECO-10 - EMCS ADDITIONS BASELINE ENERGY USAGE	Checked By	Date	TO TIME CLOCK USAGE  4-221
		GBL	9-16-93	
		Prepared By		
Project	FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY	GBL	Sheet No.	
		Job No. 93056 01	B-1	

## BASELINE ENERGY USAGE

BLDG #  
6627

COOLING - BIN METHOD 2 AHU'S @ 65,000  $\frac{\text{BTU}}{\text{HR}}$  EACH

<u>BIN</u>	<u>HRS/YR</u>	<u>% FULL LOAD</u>	<u>FULL LOAD BTU/HR</u>	<u><math>\frac{\text{BTU}}{\text{YR}}</math></u>
95/99	3	* 1.0	* 130,000	= <u>390,000</u>
90/94	17	* 1.0	* 130,000	= <u>2,210,000</u>
85/89	75	* 0.85	* 130,000	= <u>8,287,000</u>
80/84	185	* 0.70	* 130,000	= <u>16,835,000</u>
75/79	407	* 0.55	* 130,000	= <u>29,100,000</u>
70/74	714	* 0.40	* 130,000	= <u>37,128,000</u>
65/69	673	* 0.25	* 130,000	= <u>21,872,000</u>

TOTAL  
HRS/YR = 2074

TOTAL  $\frac{\text{BTU}}{\text{YR}} = 116 \times 10^6$

TOTAL ELECTRICAL ENERGY INPUT COOLING =  $\frac{116 \times 10^6 \frac{\text{BTU}}{\text{YR}}}{2} \div 2 \text{ (AVG. C.O.P.)}$   
=  $58 \times 10^6 \text{ BTU/YR (ELEC)}$

NOTE : HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 3 A.M.

### AUXILIARIES :

FANS : 20 HP \* 2545  $\frac{\text{BTU}}{\text{HP HR}} * 1.0 * \frac{2074}{2074} = 105 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$

FOR THE HOURS FROM 5 P.M. TO 3 A.M.:

TOTAL BASELINE COOLING ENERGY =  $163 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$   
THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS  
FOR IMPLEMENTING THIS ECO

Title	ECO-10 - EMCS ADDITIONS	Checked By	GSL	Date	9-21-93
	BASELINE COOLING ENERGY	Prepared By	GSL	Sheet No.	2-7
Project	FORT CAMPBELL ENERGY SAVINGS	Job No.	03001		



## PROPOSED ENERGY USAGE

BLDG#  
6627

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED  
HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM  
(EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(1.8 \times 10^6) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 1.29 \times 10^6 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right)}{12 (68 - 4)^{\circ}\text{F}} (0.6) + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 (1.29 \times 10^6 \frac{\text{BTU}}{\text{HR}})}{(0.65) (64)} (0.6) + \frac{(24 - 12) (2673 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 2294 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE } \text{PUMP} \text{ AUX. ENERGY} - \text{PROPOSED } \text{PUMP} \text{ AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = \frac{22.2 \times 10^6 \text{ BTU}}{\text{YR}} (\text{FROM SHEET F-1}) - \left[ 2 \text{ HP} * 2545 * 0.6 \left( \frac{\text{NEW DIV. FACTOR}}{\text{FACTORY}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 8.9 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC}) \quad \text{TOTAL ENERGY SAVINGS} = 388 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
	PROPOSED ENERGY USAGE	Prepared By	GBL	Sheet No.	F-1
Project	FT. CAMPBELL ENERGY SAVINGS	Job No.	25-1-1		

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 13:12:39

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 6627

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S   E D I T I O N  
COMPOSER Plus Copyright (C) 1985, 1988  
by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-224

PROJECT ID: 662710

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 6627  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 13:12:39

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS										
16111 1100 RIGID GALVANIZED STEEL CONDUIT										
CD=4 EL 1121	1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100		400.00 LP EELEF		31	937	4	360	18		1,319
16120 1200 SINGLE STRANDED CONDUCTOR										
CD=4 EL 1211	NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100	INSULATION	0.10 MLF EELEF		1	17	0	5	0		23
16130 1200 NEMA 1 SCREW COVER ENCL										
CD=4 EL 1202	6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100		5.00 EA EELEB		3	110	0	24	1		136
16900 CONTROLS AND INSTRUMENTATION										
16920 2000 CONTROL CABLE										
CD=3 EL 2001	TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100		0.80 MLF EELEF		7	200	1	656	33		890
16920 3000 CONTROL SWITCH										
CD=3 EL 3001	START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100		4.00 EA EELEB		20	660	3	240	12		915
16920 4000 RELAY										
CD=3 EL 4001	STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100		4.00 EA EELEB		5	165	1	80	4		250
CD=3 EL 4002	CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100		2.00 EA EELEB		3	83	0	170	9		261
16961 3000 TEMPERATURE										
CD=3 EL 3001	SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100		2.00 EA EELEB		5	165	1	80	4		250
CD=3 EL 3002	DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100		6.00 EA EESMA		12	377	8	270	14		669
CD=3 EL 3004	PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100		2.00 EA EPIPA		9	267	1	120	6		394

CREW ID: ORL290

CURRENCY in DOLLARS

4-226  
 PROJECT ID: 662710

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 6627  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 13:12:39

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE										
CD=3 EL 4002	DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100	SENSOR	2.00 EA EESMA		4	126		3	70	4	202
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	1.00 EA EPIPA		9	267		1	85	4	357
16962 PRESSURE SWITCHES										
CD=3 EL 1001	PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100		2.00 EA EESMA		4	126		3	160	8	296
16963 FLOW SWITCHES										
CD=3 EL 1001	FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100		1.00 EA EELEB		3	83		0	190	10	282
CD=3 EL 1002	FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100		1.00 EA MSPFB		5	138		2	0	0	140
16991 5000 MUX										
CD=3 EL 5001	MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100		1.00 EA EELEB		5	165		1	4,720	236	5,122
16991 6000 CABINET										
CD=3 EL 6001	DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100		1.00 EA EELEB		3	83		0	350	18	450
CD=3 EL 6002	INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100		1.00 EA EELEB		3	83		0	125	6	214
16991 7000 SOFTWARE										
CD=3 EL 7001	PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100		26.00 EA EELEB		33	1,073		4	780	39	1,896
TOTAL DIVISION 16 ELECTRICAL					161	5,123	33	8,486	424	14,066
TOTAL FACILITY AA. ELECTRICAL					161	5,123	33	8,486	424	14,066
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					161	5,123	33	8,486	424	14,066
TOTAL BASE BID					161	5,123	33	8,486	424	14,066

CREW ID: ORL290

CURRENCY in DOLLARS

 PROJECT ID: 662710  
 4-227

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627  
2. SITEWORK /

TIME 13:12:39

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				161	5,123	33	8,486	424	14,066

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-228  
PROJECT ID: 662710

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL	1.00 EA	14,066	10.0% 1,407	0.0% 0	7.5% 1,160	2.5% 416	0.0% 0	17,049	17048.57
BID ITEM TOTAL		1.00 EA	14,066	1,407	0	1,160	416	0	17,049	17048.57

CREW ID: ORL290

CURRENCY in DOLLARS

4-230  
PROJECT ID: 662710



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	14,066	1,407	0	1,160	416	0	17,049	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	14,066	1,407	0	1,160	416	0	17,049	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 662710<sup>4-231</sup>

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00 EA	17,049		17,049	17048.60
	TOTAL CURRENT CONTRACT COST		17,049	0	17,049	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		17,049	0	17,049	
	Government-Furnished Property		0		0	
	SUBTOTAL		17,049	0	17,049	
	Contingencies	10.0%	1,705	0	1,705	
	SUBTOTAL		18,753	0	18,753	
	SIOH (S&A)	5.0%	938	0	938	
	CURRENT WORKING ESTIMATE		19,691	0	19,691	

Estimated Construction Time 365 Days

4-232

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 662710

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	161	5,123	33	8,910	14,066	100.0%	0	14,066
	TOTAL DIRECT				161	5,123	33	8,910	14,066	100.0%		

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

-----			*** OVERHEAD ***		-----		**** PROFIT ****		-----		***** TOTAL CONTRACT *****		
ID	CONTRACTOR	PM	SUBTOTAL	AMOUNT	PCT	HOFC%	AMOUNT	PCT	BOND%	OTHER%	AMOUNT	PCT	UNIT COST
-----			-----		-----		-----		-----		-----		
AA	GENERAL/PRIME		14,066	1,407	10.0%	0.0	1,160	7.5%	2.5%	0.0%	17,049	100.0%	17048.54
			-----		-----		-----		-----				
					1,407 10.0%		1,160 7.5%						

CREW ID: ORL290

CURRENCY in DOLLARS

4-234  
PROJECT ID: 662710

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	161	5,123	33	8,486	424	14,066
TOTAL DIRECT	161	5,123	33	8,486	424	14,066

CREW ID: ORL290

CURRENCY in DOLLARS

4-235  
PROJECT ID: 662710

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	161	5,123	33	8,486	424	14,066
TOTAL DIRECT	161	5,123	33	8,486	424	14,066

CREW ID: ORL290

CURRENCY in DOLLARS

4-236

PROJECT ID: 662710

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

EQUIPMENT SUMMARY

SUMMARY PAGE 9

----- *** BOOK VALUE ***		ADJ FACTOR	ADJUSTD	BOOK OP	--	HRLY	---	UPB	****	TOTAL	****		
EQUIP	DESCRIPTION	LIFE HRS	TL	HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
EMI20	SMALL TOOLS									1.40	1.40	23	33
												-----	-----
TOTAL PROJECT EQUIPMENT HOURS												23	33

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6627

TIME 13:12:39

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	138	4,447
LSHMT	SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	10	299
LSPFI	STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	13	376
TOTAL PROJECT MANHOURS									161	5,122

\* \* \* END OF SUMMARY REPORT \* \* \*



## SUMMARY SHEET

BLOG #  
6636

$$\begin{aligned} \text{FUEL OIL SAVINGS} &= \frac{297 \text{ MBTU}}{\text{YR}} * \$ \frac{4.98}{\text{MBTU}} = \$ 1479 \\ \text{ELECTRICAL SAVINGS} &= \frac{800 \text{ MBTU}}{\text{YR}} * \$ \frac{6.19}{\text{MBTU}} = \$ 4952 \end{aligned}$$

$$\text{TOTAL SAVINGS} = \$ 6431 / \text{YR}$$

## HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
<u>1</u>	FID/MUX
<u>4</u>	MUX ONLY
<u>8</u>	SPACE TEMP SENSOR
<u>6</u>	DUCT TEMP SENSOR
<u>6</u>	WATER TEMP SENSOR
<u>1</u>	D.A. TEMP SENSOR
<u>1</u>	HUMIDITY SENSOR
<u>9</u>	START/STOP
<u>9</u>	STATUS RELAY
<u>4</u>	DIFF. PRESSURE (DUCT)
<u>3</u>	DIFF. PRESSURE (PIPE)
<u>2</u>	FLOW SWITCH
<u>4</u>	PRESSURE SWITCH
<u>8</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>800</u> FT.	- 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>400</u> FT.	- RIGID CONDUIT - 1" D.
<u>6</u>	JUNCTION BOXES
<u>49</u>	PROGRAMMING POINTS
<u>200</u> FT.	POWER WIRING

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-17-93
	SUMMARY SHEET	Prepared By	GBL	Sheet No.	5-1
	Project	Job No.	92001 01		
	FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY STUDY				

## BASELINE ENERGY USAGE

BLDG #

6636

### HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4) ^\circ \text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290 ^\circ \text{F-DAY}) \left(1.4 \times 10^6 \frac{\text{BTU}}{\text{HR}}\right)}{(0.65) (68 - 4) ^\circ \text{F}} (0.6)$$

$$\text{ENERGY} = 2079 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \frac{\text{FUEL OIL}}{\text{NATURAL GAS}} \right)$$

### AUXILIARY EQUIPMENT:

FANS: ENERGY = FAN HP \* 2545  $\frac{\text{BTU}}{\text{HR} \cdot \text{HP}}$  \* DIVERSITY FACTOR \*  $\frac{\text{HEATING HRS}}{\text{YR}}$

$$\text{ENERGY} = 40 * 2545 * 1.0 * 4369 = 445 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC})$$

PUMPS: ENERGY = PUMP HP \* 2545  $\frac{\text{BTU}}{\text{HR} \cdot \text{HP}}$  \* DIVERSITY FACTOR \*  $\frac{\text{HTG HRS}}{\text{YR}}$

$$\text{ENERGY} = 10.5 * 2545 * 1.0 * 4369 = 117 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC})$$

$$\text{TOTAL BASELINE HEATING ENERGY} = 2641 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title ECO-10 - EMCS ADDITIONS  
BASELINE ENERGY USAGE

Checked By GBL

Date 9-16-93

Project FT. CAMPBELL ENERGY SAVINGS  
OPPORTUNITY SURVEY

Prepared By GBL

Job No. 93000001

Sheet No. B-1

## BASLINE ENERGY USAGE

BLDG #  
6636

### COOLING - BIN METHOD

<u>BIN</u>	<u>HRS/YR</u>		<u>% FULL LOAD</u>	<u>FULL LOAD BTU/Hr</u>	<u>BTU/YR</u>
95/99	3	*	1.0	* 60,000	= <u>180,000</u>
90/94	17	*	1.0	* 60,000	= <u>1,020,000</u>
85/89	75	*	0.85	* 60,000	= <u>3,825,000</u>
80/84	185	*	0.70	* 60,000	= <u>7,770,000</u>
75/79	407	*	0.55	* 60,000	= <u>13,431,000</u>
70/74	714	*	0.40	* 60,000	= <u>17,136,000</u>
65/69	673	*	0.25	* 60,000	= <u>10,095,000</u>

TOTAL  
HRS/YR = 2074

TOTAL BTU/YR = 53,457,000

$$\begin{aligned} \text{TOTAL ELECTRICAL ENERGY INPUT COOLING} &= \frac{53 \times 10^6 \text{ BTU}}{\text{YR}} \div 2 \text{ (AVG. C.O.P.)} \\ &= \underline{27 \times 10^6 \text{ BTU/YR (ELEC)}} \end{aligned}$$

NOTE : HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 8 A.M.

### AUXILIARIES :

$$\text{FANS : } \underline{40} \text{ HP} \times 2545 \frac{\text{BTU}}{\text{HP HR}} \times 1.0 \times 2074 = \underline{211 \times 10^6 \frac{\text{BTU}}{\text{YR}}} \text{ (ELEC)}$$

FOR THE HOURS FROM 5 P.M. TO 8 A.M.:

$$\begin{aligned} \text{TOTAL BASELINE COOLING ENERGY} &= \underline{238 \times 10^6 \frac{\text{BTU}}{\text{YR}}} \text{ (ELEC)} \\ \text{THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS} & \\ \text{FOR IMPLEMENTING THIS ECO} & \end{aligned}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-21-93
	BASLINE COOLING ENERGY	Prepared By	GBL		
Project	FORT CAMPBELL ENERGY SAVINGS	Job No.	2-7	Sheet No.	4-241

## PROPOSED ENERGY USAGE

BLDG #

6636

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED  
HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM  
(EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(1.4 \times 10^6) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 1 \times 10^6 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HR}} \right)}{24 (68 - 4)^{\circ}\text{F}} (0.6) + \frac{\left( \frac{24 - \text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 \left( 1 \times 10^6 \frac{\text{BTU}}{\text{HR}} \right)}{(0.45) (64)} (0.6) + \frac{(24 - 12) (2079 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 1782 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \frac{\text{FUEL OIL}}{\text{NATURAL GAS}} \right)$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE AUX. ENERGY} - \text{PROPOSED AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = 562 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ 50.5 \text{ HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACTUAL}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 225 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{ELEC} \right) \quad \text{TOTAL ENERGY SAVINGS} = 522 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title ECO-10 - EMCS ADDITIONS

PROPOSED ENERGY USAGE

Project FT. CAMPBELL ENERGY SAVINGS

Checked By

GBL

Prepared By

GBL

Job No.

02-11-91

Date

9-16-93

Sheet No.

F-1

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 10:29:03

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 6636

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-243  
PROJECT ID: 663610

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

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DETAILED ESTIMATE

DETAIL PAGE

1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 6636  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 10:29:03

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100	400.00 LF EELEF			31	937	4	360	18	1,319
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION	0.20 MLF EELEF			1	35	0	11	1	46
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100	6.00 EA EELEB			4	132	1	29	1	163
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100	0.80 MLF EELEF			7	200	1	656	33	890
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100	9.00 EA EELEB			45	1,485	6	540	27	2,058
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100	9.00 EA EELEB			11	371	1	180	9	562
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100	8.00 EA EELEB			10	330	1	680	34	1,045
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100	4.00 EA EELEB			10	330	1	160	8	499
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100	8.00 EA EESMA			16	502	11	360	18	892
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100	6.00 EA EPIPA			26	802	2	360	18	1,182

4-245

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 663610

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 6636  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 10:29:03

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE										
CD=3 EL 4002	DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100	SENSOR	4.00 EA EESMA		8	251	6	140	7		404
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	3.00 EA EPIPA		26	802	2	255	13		1,072
16962 PRESSURE SWITCHES										
CD=3 EL 1001	PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100		4.00 EA EESMA		8	251	6	320	16		593
16963 FLOW SWITCHES										
CD=3 EL 1001	FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100		2.00 EA EELEB		5	165	1	380	19		565
CD=3 EL 1002	FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100		2.00 EA MSPFB		10	275	4	0	0		279
16991 5000 MUX										
CD=3 EL 5001	MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100		1.00 EA EELEB		5	165	1	4,720	236		5,122
16991 6000 CABINET										
CD=3 EL 6001	DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100		1.00 EA EELEB		3	83	0	350	18		450
CD=3 EL 6002	INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100		1.00 EA EELEB		3	83	0	125	6		214
16991 7000 SOFTWARE										
CD=3 EL 7001	PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100		49.00 EA EELEB		61	2,022	8	1,470	74		3,573
TOTAL DIVISION 16 ELECTRICAL					288	9,222	56	11,096	555	20,929
TOTAL FACILITY AA. ELECTRICAL					288	9,222	56	11,096	555	20,929
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					288	9,222	56	11,096	555	20,929
TOTAL BASE BID					288	9,222	56	11,096	555	20,929

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 663610  
4-246



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636  
2. SITEWORK /

TIME 10:29:03

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				288	9,222	56	11,096	555	20,929

\* \* \* END OF DETAIL REPORT \* \* \*

4-247

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 663610

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

CREW ID: ORL290

CURRENCY in DOLLARS

4-248  
PROJECT ID: 663610

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	20,929	2,093	0	1,727	619	0	25,367	25366.72
BID ITEM TOTAL		1.00 EA	20,929	2,093	0	1,727	619	0	25,367	25366.72

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	20,929	2,093	0	1,727	619	0	25,367	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	20,929	2,093	0	1,727	619	0	25,367	

CREW ID: ORL290

CURRENCY in DOLLARS

4-250  
PROJECT ID: 663610

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1. BUILDING TO THE 5 FOOT LINE	1.00 EA	25,367		25,367	25366.70
TOTAL CURRENT CONTRACT COST		25,367	0	25,367	
Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%	0	0	0	
ESCALATED CONTRACT COST		25,367	0	25,367	
Government-Furnished Property		0		0	
SUBTOTAL		25,367	0	25,367	
Contingencies	10.0%	2,537	0	2,537	
SUBTOTAL		27,903	0	27,903	
SIOH (S&A)	5.0%	1,395	0	1,395	
CURRENT WORKING ESTIMATE		29,299	0	29,299	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

4-251  
PROJECT ID: 663610

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	288	9,222	56	11,651		20,929	100.0%	0	20,929
	TOTAL DIRECT				288	9,222	56	11,651		20,929	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

4-252  
PROJECT ID: 663610

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

-----		*** OVERHEAD ***			-----		**** PROFIT ****			-----		***** TOTAL CONTRACT *****		
ID	CONTRACTOR	PM	SUBTOTAL	AMOUNT	PCT	HOFC%	AMOUNT	PCT	BOND%	OTHER%	AMOUNT	PCT	UNIT COST	
-----		-----		-----		-----		-----		-----		-----		
AA	GENERAL/PRIME		20,929	2,093	10.0%	0.0	1,727	7.5%	2.5%	0.0%	25,367	100.0%	25366.70	
				-----			-----							
				2,093	10.0%		1,727	7.5%						
				-----			-----							
				2,093	10.0%		1,727	7.5%						
				-----			-----							

CREW ID: ORL290

CURRENCY in DOLLARS

4-253  
PROJECT ID: 663610

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	288	9,222	56	11,096	555	20,929
TOTAL DIRECT	288	9,222	56	11,096	555	20,929

CREW ID: ORL290

CURRENCY in DOLLARS

4-254  
PROJECT ID: 663610



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	288	9,222	56	11,096	555	20,929
TOTAL DIRECT	288	9,222	56	11,096	555	20,929

CREW ID: ORL290

CURRENCY in DOLLARS

4-255

PROJECT ID: 663610

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTH	OWNRSH	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
EMI20 SMALL TOOLS								1.40	1.40	40	56
TOTAL PROJECT EQUIPMENT HOURS										40	56

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6636

TIME 10:29:03

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	238	7,753
LSHMT	SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	16	478
LSPFI	STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	34	991
TOTAL PROJECT MANHOURS									288	9,223

\* \* \* END OF SUMMARY REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-257  
PROJECT ID: 663610

## SUMMARY SHEET

BLOG #

6921-A

$$\text{NATURAL GAS SAVINGS} = \frac{0 \text{ MBTU}}{\text{YR}} * \$ \frac{4.00}{\text{MBTU}} = \$ 0$$

$$\text{ELECTRICAL SAVINGS} = \frac{0 \text{ MBTU}}{\text{YR}} * \$ \frac{6.19}{\text{MBTU}} = \$ 0$$

$$\text{TOTAL SAVINGS} = \$ 0 / \text{YR}$$

## HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
—	FID/MUX
—	MUX ONLY
—	SPACE TEMP SENSOR
—	DUCT TEMP SENSOR
4	WATER TEMP SENSOR
—	D.A. TEMP SENSOR
—	HUMIDITY SENSOR
4	START/STOP
4	STATUS RELAY
—	DIFF. PRESSURE (DUCT)
4	DIFF. PRESSURE (PIPE)
3	FLOW SWITCH
—	PRESSURE SWITCH
4	CURRENT RELAY
1	DATA TERMINAL CABINET
1	INSTRUMENT ENCLOSURE
900	FT. — 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
500	FT. — RIGID CONDUIT — 1" D.
4	JUNCTION BOXES
19	PROGRAMMING POINTS
100	FT. — POWER WIRING

Title ECO-10 - EMCS ADDITIONS

SUMMARY SHEET

Checked By

GSL

Date

9-17-93

Prepared By

GEL

Project

FT. CAMPBELL ENERGY SAVINGS

Sheet No.

OPPORTUNITY STUDY

Job No.

22001-01

C-1

## BASELINE ENERGY USAGE

BLDG #  
6921-A

### COOLING - BIN METHOD

BIN	HRS/YR	% FULL LOAD	570 TONS FULL LOAD BTU/HR	BTU YR
95/99	3	* 1.0	* 0	= 0
90/94	17	* 1.0	* 0	= 0
85/89	75	* 0.85	* 0	= 0
80/84	185	* 0.70	* 0	= 0
75/79	407	* 0.55	* 0	= 0
70/74	714	* 0.40	* 0	= 0
65/69	673	* 0.25	* 0	= 0

TOTAL  
HRS/YR = 2074

TOTAL BTU/YR = 0

TOTAL ELECTRICAL ENERGY INPUT COOLING =  $0 \frac{\text{BTU}}{\text{YR}} \div 2 (\text{AVG. C.O.P.})$   
= 0 BTU/YR (ELEC)

NOTE: HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 8 A.M.

### AUXILIARIES:

1 CH.W. PUMP @ 75 HP; 1 COND. WTR. PUMP @ 50 HP

Pumps:  $0 \text{ HP} \times 2545 \frac{\text{BTU}}{\text{HP-HR}} \times 1.0 \times 2074 = 0 \frac{\text{BTU}}{\text{YR}} (\text{ELEC})$

FOR THE HOURS FROM 5 P.M. TO 8 A.M.

TOTAL BASELINE COOLING ENERGY = 0 BTU/YR  
THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS  
FOR IMPLEMENTING THIS ECO

Project	Title ECO-10 - EMCS ADDITIONS	Checked By GBL	Date 9-21-93
	BASELINE COOLING ENERGY	Prepared By GBL	Sheet No.
	WALT CAMPBELL ENERGY SAVINGS	Job No.	2-7

## BASELINE ENERGY USAGE

NO HEATING

BLDG #

6921-A

HEATING: DEGREE DAY METHOD

IN THIS BUILDING

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4) ^\circ\text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \left( 24 \frac{\text{HR}}{\text{DAY}} \right) (4290 ^\circ\text{F-DAY}) \left( \frac{\text{BTU}}{\text{HR}} \right) \frac{(0.6)}{(68 - 4) ^\circ\text{F}}$$

$$\text{ENERGY} = \underline{0} \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

AUXILIARY EQUIPMENT:

$$\text{FANS: ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{0} * 2545 * \underline{\quad} * 4369 = \underline{\quad} \frac{\text{BTU}}{\text{YR}} (\text{ELEC})$$

$$\text{PUMPS: ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{0} * 2545 * 1.0 * 4369 = \underline{\quad} \frac{\text{BTU}}{\text{YR}} (\text{ELEC})$$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{0} \frac{\text{BTU}}{\text{YR}}$$

Title ECO-10 - EMCS ADDITIONS BASELINE ENERGY USAGE	Checked By GBL	Date 9-16-93
Project FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY	Prepared By GBL	Sheet No. B-1
Job No. 93006.01		4-260

## PROPOSED ENERGY USAGE

NO HEATING

BLDG #

6921-A

HEATING: DEGREE DAY METHOD IN THIS BUILDING

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SET POINTS DURING UNOCCUPIED HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (-4) = ^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \left( \frac{\quad}{(68 - 4)^{\circ}\text{F}} \right) \frac{\text{BTU}}{\text{HR}} * (-4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = \frac{\quad}{\quad} \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right)}{n (68 - 4)^{\circ}\text{F}} (0.6) + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{\left( \frac{\text{HRS}}{\quad} \right) 4290 \left( \frac{\text{BTU}}{\text{HR}} \right)}{\left( \quad \right) (64)} (0.6) + \frac{\left( 24 - \quad \right) \left( \quad \right)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = \frac{0}{\text{YR}} \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE AUX. ENERGY} - \text{PROPOSED AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ \text{HP} * 2545 * \left( \frac{\text{DIV. FACTOR}}{\quad} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = \frac{0}{\text{YR}} \frac{\text{BTU}}{\text{YR}} (\text{ELEC}) \quad \text{TOTAL ENERGY SAVINGS} = \frac{\quad}{\text{YR}} \frac{\text{BTU}}{\text{YR}}$$

<p>Title ECO-10 - EMCS ADDITIONS</p> <p>PROPOSED ENERGY USAGE</p>	<p>Checked By GBL</p> <p>Prepared By GBL</p>	<p>Date 9-16-93</p>
<p>Project FT. CAMPBELL ENERGY SAVINGS</p>	<p>Job No. 02-11-01</p>	<p>Sheet No. F-1</p>

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 07:26:04

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
COMPOSER Plus Copyright (C) 1985, 1988  
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Release 4.20

4-262

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 692110



Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

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LABOR SUMMARY.....	10

DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	.
AA. ELECTRICAL.....	1

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Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 6921A  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 07:26:04

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS										
16111 1100 RIGID GALVANIZED STEEL CONDUIT										
CD=4 EL 1121	1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100		500.00 LF EELEF		39	1,171	5	450	23		1,649
16120 1200 SINGLE STRANDED CONDUCTOR										
CD=4 EL 1211	NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100	INSULATION	0.10 MLF EELEF		1	17	0	5	0		23
16130 1200 NEMA 1 SCREW COVER ENCL										
CD=4 EL 1202	6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100		4.00 EA EELEB		3	88	0	19	1		109
16900 CONTROLS AND INSTRUMENTATION										
16920 2000 CONTROL CABLE										
CD=3 EL 2001	TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100		0.90 MLF EELEF		7	225	1	738	37		1,001
16920 3000 CONTROL SWITCH										
CD=3 EL 3001	START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100		4.00 EA EELEB		20	660	3	240	12		915
16920 4000 RELAY										
CD=3 EL 4001	STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100		4.00 EA EELEB		5	165	1	80	4		250
CD=3 EL 4002	CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100		4.00 EA EELEB		5	165	1	340	17		523
16961 3000 TEMPERATURE										
CD=3 EL 3004	PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100		4.00 EA EPIPA		17	535	1	240	12		788
16961 4000 PRESSURE										
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	4.00 EA EPIPA		34	1,070	3	340	17		1,429
16963 FLOW SWITCHES										

CREW ID: ORL290

CURRENCY in DOLLARS

4-264

PROJECT ID: 692110

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 6921A  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 07:26:04

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16963 FLOW SWITCHES									
CD=3 EL 1001 FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100	3.00 EA EELEB			8	248	1	570	29	847
CD=3 EL 1002 FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100	3.00 EA MSPFB			15	413	6	0	0	419
16991 6000 CABINET									
CD=3 EL 6001 DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100	1.00 EA EELEB			3	83	0	350	18	450
CD=3 EL 6002 INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100	1.00 EA EELEB			3	83	0	125	6	214
16991 7000 SOFTWARE									
CD=3 EL 7001 PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100	19.00 EA EELEB			24	784	3	570	29	1,386
TOTAL DIVISION 16 ELECTRICAL				182	5,706	25	4,068	203	10,002
TOTAL FACILITY AA. ELECTRICAL				182	5,706	25	4,068	203	10,002
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				182	5,706	25	4,068	203	10,002
TOTAL BASE BID				182	5,706	25	4,068	203	10,002
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				182	5,706	25	4,068	203	10,002

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

 4-265  
 PROJECT ID: 692110

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

CREW ID: ORL290

CURRENCY in DOLLARS

4-266  
PROJECT ID: 692110

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	10,002	1,000	0	825	296	0	12,123	12123.32
BID ITEM TOTAL		1.00 EA	10,002	1,000	0	825	296	0	12,123	12123.32

CREW ID: ORL290

CURRENCY in DOLLARS

4-267

PROJECT ID: 692110

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER PCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	10,002	1,000	0	825	296	0	12,123	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	10,002	1,000	0	825	296	0	12,123	

CREW ID: ORL290

CURRENCY in DOLLARS

4-268

PROJECT ID: 692110

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 6921A

TIME 07:26:04

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00 EA	12,123		12,123	12123.30
	TOTAL CURRENT CONTRACT COST		12,123	0	12,123	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		12,123	0	12,123	
	Government-Furnished Property		0		0	
	SUBTOTAL		12,123	0	12,123	
	Contingencies	10.0%	1,212	0	1,212	
	SUBTOTAL		13,336	0	13,336	
	SIOH (S&A)	5.0%	667	0	667	
	CURRENT WORKING ESTIMATE		14,002	0	14,002	

Estimated Construction Time 365 Days

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PH	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT * AMOUNT PCT	** SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	182	5,706	25	4,271		10,002 100.0%	0	10,002
	TOTAL DIRECT				182	5,706	25	4,271		10,002 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

4-270

PROJECT ID: 692110



Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		10,002	1,000	10.0%	0.0	825	7.5%	2.5%	0.0%	12,123	100.0%	12123.31
	TOTAL OVERHEAD & PROFIT			1,000	10.0%		825	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

4-271  
PROJECT ID: 692110

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	182	5,706	25	4,068	203	10,002
TOTAL DIRECT	182	5,706	25	4,068	203	10,002

CREW ID: ORL290

CURRENCY in DOLLARS

4-272  
PROJECT ID: 692110

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	182	5,706	25	4,068	203	10,002
TOTAL DIRECT	182	5,706	25	4,068	203	10,002

CREW ID: ORL290

CURRENCY in DOLLARS

4-273  
PROJECT ID: 692110

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

EQUIPMENT SUMMARY

SUMMARY PAGE 9

----- *** BOOK VALUE *** ADJ FACTOR ADJUSTD BOOK OP -- HRLY --- UPB **** TOTAL ****											
EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
-----											
EMI20 SMALL TOOLS								1.40	1.40	18	25
										-----	-----
TOTAL PROJECT EQUIPMENT HOURS										18	25

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 6921A

TIME 07:26:04

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	-- UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	143	4,576
LSPFI STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	39	1,129
TOTAL PROJECT MANHOURS								182	5,705

\* \* \* END OF SUMMARY REPORT \* \* \*

## SUMMARY SHEET

BLOG #

7243

$$\text{NATURAL GAS SAVINGS} = \frac{966 \text{ MBTU}}{\text{YR}} \times \frac{\$4.00}{\text{MBTU}} = \$3864$$

$$\text{ELECTRICAL SAVINGS} = \frac{523 \text{ MBTU}}{\text{YR}} \times \frac{\$6.19}{\text{MBTU}} = \$3237$$

$$\text{TOTAL SAVINGS} = \$7101/\text{YR}$$

### HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
<u>1</u>	FID/MUX
<u>1</u>	MUX ONLY
<u>8</u>	SPACE TEMP SENSOR
<u>18</u>	DUCT TEMP SENSOR
<u>2</u>	WATER TEMP SENSOR
<u>1</u>	D.A. TEMP SENSOR
<u>1</u>	HUMIDITY SENSOR
<u>11</u>	START/STOP
<u>11</u>	STATUS RELAY
<u>8</u>	DIFF. PRESSURE (DUCT)
<u>2</u>	DIFF. PRESSURE (PIPE)
<u>1</u>	FLOW SWITCH
<u>8</u>	PRESSURE SWITCH
<u>10</u>	CURRENT RELAY
<u>1</u>	ALLOY } DATA TERMINAL CABINET
<u>1</u>	" IN PLACE } INSTRUMENT ENCLOSURE
<u>1200</u>	FT. - 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>600</u>	FT. - RIGID CONDUIT - 1" D.
<u>10</u>	JUNCTION BOXES
<u>68</u>	PROGRAMMING POINTS
<u>300</u>	FT. POWER WIRING

Title	ECO-10 - EMCS ADDITIONS	Checked By	GSL	Date	9-17-93
	SUMMARY SHEET	Prepared By	GSL	Sheet No.	
	Project	Job No.			

## BASELINE ENERGY USAGE

BLDG #

7243

HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ\text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ\text{F-DAY}) \left(4.8 \times 10^6 \frac{\text{BTU}}{\text{HR}}\right)}{(0.65) (68 - 4)^\circ\text{F}} (0.6)$$

$$\text{ENERGY} = \underline{71.28 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

AUXILIARY EQUIPMENT:

8 @ 5 HP

$$\text{FANS: ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{40} * 2545 * \underline{1.0} * 4369 = \underline{445 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

PUMPS:

1 @ 5 ; 1 @ 1

$$\text{ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HTG HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{6} * 2545 * 1.0 * 4369 = \underline{67 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{7112 \times 10^6} \frac{\text{BTU}}{\text{YR}}$$

Title ECO-10 - EMCS ADDITIONS  
BASELINE ENERGY USAGE

Checked By GBL

Date 9-16-93

Project FT. CAMPBELL ENERGY SAVINGS  
OPPORTUNITY SURVEY

Prepared By GBL

Sheet No.

Job No. 92-2-1-1

B-1

## BASILINE ENERGY USAGE

BLDG #

7243

### COOLING - BIN METHOD

2 @ 10 TONS EA

<u>BIN</u>	<u>HRS/YR</u>	<u>% FULL LOAD</u>	<u>FULL LOAD BTU/HR</u>	<u>BTU/YR</u>
95/99	3	* 1.0	* 240,000	= <u>720,000</u>
90/94	17	* 1.0	* 240,000	= <u>4,080,000</u>
85/89	75	* 0.85	* 240,000	= <u>15,300,000</u>
80/84	185	* 0.70	* 240,000	= <u>31,080,000</u>
75/79	407	* 0.55	* 240,000	= <u>53,724,000</u>
70/74	714	* 0.40	* 240,000	= <u>68,544,000</u>
65/69	673	* 0.25	* 240,000	= <u>40,380,000</u>

TOTAL  
HRS/YR = 2074

TOTAL  $\frac{BTU}{YR}$  = 213,828,000

$$\begin{aligned} \text{TOTAL ELECTRICAL ENERGY INPUT COOLING} &= \frac{214 \times 10^6 \text{ BTU}}{YR} \div 2 \left( \frac{\text{AVG.}}{\text{C.O.P.}} \right) \\ &= \underline{107 \times 10^6 \text{ BTU/YR (ELEC)}} \end{aligned}$$

NOTE : HRS/YR INDICATE THE TOTAL ANNUAL OCCURENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 3 A.M.

### AUXILIARIES !

$$\text{FANS : } \underline{40} \text{ HP} \approx 545 \frac{\text{BTU}}{\text{HP HR}} \times 1.0 \times 2074 = \underline{211 \times 10^6 \frac{\text{BTU}}{YR} \text{ (ELEC)}}$$

FOR THE HOURS FROM 5 P.M. TO 3 A.M.:

$$\begin{aligned} \text{TOTAL BASELINE COOLING ENERGY} &= \underline{318 \times 10^6 \frac{\text{BTU}}{YR} \text{ (ELEC)}} \\ \text{THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS} & \\ \text{FOR IMPLEMENTING THIS ECO} & \end{aligned}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date
	BASILINE COOLING ENERGY	Prepared By	GBL	9-21-93
	Project	Job No.		Sheet No.
	FORT CAMPBELL ENERGY SAVINGS			2-7



## PROPOSED ENERGY USAGE

BLDG #  
7243

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(4.8 \times 10^6) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 3.5 \times 10^6 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right) (0.6)}{24 (68 - 4)^{\circ}\text{F}} + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 (3.5 \times 10^6 \frac{\text{BTU}}{\text{HR}}) (0.6)}{(0.65) (64)} + \frac{(24 - 12) (7128 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 6162 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

AUXILIARY ENERGY SAVINGS = BASELINE AUX. ENERGY - PROPOSED AUX. ENERGY

$$\text{AUX. ENRG. SAVINGS} = 512 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ 46 \text{ HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACT}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 205 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC}) \quad \text{TOTAL ENERGY SAVINGS} = 1171 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
	PROPOSED ENERGY USAGE	Prepared By	GBL	Sheet No.	
Project	FT. CAMPBELL ENERGY SAVINGS	Job No.			4-279

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 12:21:59

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 7243

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-280  
PROJECT ID: 724310

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

TIME 12:21:59

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DETAILED ESTIMATE

DETAIL PAGE

1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

\* \* \* END TABLE OF CONTENTS \* \* \*

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7243  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:21:59

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100 600.00 LF EELEF			47	1,405	6	540	27		1,979
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION 0.30 MLF EELEF			2	52	0	16	1		69
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100 10.00 EA EELEB			7	220	1	49	2		272
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100 1.20 MLF EELEF			10	300	1	984	49		1,334
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100 11.00 EA EELEB			55	1,816	7	660	33		2,516
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100 11.00 EA EELEB			14	454	2	220	11		687
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100 10.00 EA EELEB			13	413	2	850	43		1,307
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100 8.00 EA EELEB			20	660	3	320	16		999
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100 18.00 EA EESMA			36	1,130	25	810	41		2,006
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100 2.00 EA EPIPA			9	267	1	120	6		394

4-282

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 724310

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7243  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:21:59

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE										
CD=3 EL 4002	DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100	SENSOR	8.00 EA EESMA		16	502		11	280	14	808
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	2.00 EA EPIPA		17	535		1	170	9	715
16962 PRESSURE SWITCHES										
CD=3 EL 1001	PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100		8.00 EA EESMA		16	502		11	640	32	1,186
16963 FLOW SWITCHES										
CD=3 EL 1001	FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100		1.00 EA EELEB		3	83		0	190	10	282
CD=3 EL 1002	FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100		1.00 EA MSPFB		5	138		2	0	0	140
16991 5000 MUX										
CD=3 EL 5001	MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100		1.00 EA EELEB		5	165		1	4,720	236	5,122
16991 7000 SOFTWARE										
CD=3 EL 7001	PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100		68.00 EA EELEB		85	2,806		11	2,040	102	4,959
TOTAL DIVISION 16 ELECTRICAL						357	11,448	85	12,609	630 , 24,772
TOTAL FACILITY AA. ELECTRICAL						357	11,448	85	12,609	630 24,772
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE						357	11,448	85	12,609	630 24,772
TOTAL BASE BID						357	11,448	85	12,609	630 24,772
TOTAL ADDITIVE						0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY						357	11,448	85	12,609	630 24,772

\*\*\* END OF DETAIL REPORT \*\*\*  
 CURRENCY in DOLLARS

4-283  
 PROJECT ID: 724310

CREW ID: ORL290

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

TIME 12:21:59

PROJECT NOTES

SUMMARY PAGE 1

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PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	24,772	2,477	0	2,044	732	0	30,025	30025.49
BID ITEM TOTAL		1.00 EA	24,772	2,477	0	2,044	732	0	30,025	30025.49

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER PCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	24,772	2,477	0	2,044	732	0	30,025	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	24,772	2,477	0	2,044	732	0	30,025	

CREW ID: ORL290

CURRENCY in DOLLARS

4-286

PROJECT ID: 724310



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

TIME 12:21:59

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	30,026		30,026	30025.50
	TOTAL CURRENT CONTRACT COST			30,026	0	30,026	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			30,026	0	30,026	
	Government-Furnished Property			0		0	
	SUBTOTAL			30,026	0	30,026	
	Contingencies	10.0%		3,003	0	3,003	
	SUBTOTAL			33,028	0	33,028	
	SIOH (S&A)	5.0%		1,651	0	1,651	
	CURRENT WORKING ESTIMATE			34,679	0	34,679	
	Estimated Construction Time	365	Days				

4-287

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 724310

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

TIME 12:21:59

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PH	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	357	11,448	85	13,239		24,772	100.0%	0	24,772
	TOTAL DIRECT				357	11,448	85	13,239		24,772	100.0%		

4-288

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 724310

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

TIME 12:21:59

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

-----		*** OVERHEAD ***			-----			**** PROFIT ****			-----			***** TOTAL CONTRACT *****		
ID	CONTRACTOR	PM	SUBTOTAL	AMOUNT	PCT	HOFC%	AMOUNT	PCT	BOND%	OTHER%	AMOUNT	PCT	UNIT	COST		
-----																
AA	GENERAL/PRIME		24,772	2,477	10.0%	0.0	2,044	7.5%	2.5%	0.0%	30,025	100.0%	30025.48			
				-----			-----									
TOTAL OVERHEAD & PROFIT				2,477	10.0%		2,044	7.5%								

CREW ID: ORL290

CURRENCY in DOLLARS

4-289  
PROJECT ID: 724310

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

TIME 12:21:59

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	357	11,448	85	12,609	630	24,772
TOTAL DIRECT	357	11,448	85	12,609	630	24,772

CREW ID: ORL290

CURRENCY in DOLLARS

4-290  
PROJECT ID: 724310

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

TIME 12:21:59

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	357	11,448	85	12,609	630	24,772
TOTAL DIRECT	357	11,448	85	12,609	630	24,772

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

TIME 12:21:59

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSHP	OWNS	OVTH	OWNRSHP	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
EMI20 SMALL TOOLS								1.40	1.40	61	85
TOTAL PROJECT EQUIPMENT HOURS										61	85

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7243

TIME 12:21:59

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	306	9,936
LSEMT SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	34	1,016
LSPFI STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	17	496
TOTAL PROJECT MANHOURS								357	11,447

\* \* \* END OF SUMMARY REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-293  
PROJECT ID: 724310

## SUMMARY SHEET

BLOG #  
**7262**

$$\text{NATURAL GAS SAVINGS} = \frac{817}{\text{YR}} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{4.00}{\text{MBTU}} = \$ \underline{3268}$$

$$\text{ELECTRICAL SAVINGS} = \frac{408}{\text{YR}} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{6.19}{\text{MBTU}} = \$ \underline{2525}$$

$$\text{TOTAL SAVINGS} = \$ \underline{5793} / \text{YR}$$

## HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
<u>1</u>	FID/MUX
<u>1</u>	MUX ONLY
<u>6</u>	SPACE TEMP SENSOR
<u>18</u>	DUCT TEMP SENSOR
<u>2</u>	WATER TEMP SENSOR
<u>1</u>	D.A. TEMP SENSOR
<u>1</u>	HUMIDITY SENSOR
<u>8</u>	START/STOP
<u>8</u>	STATUS RELAY
<u>6</u>	DIFF. PRESSURE (DUCT)
<u>1</u>	DIFF. PRESSURE (PIPE)
<u>1</u>	FLOW SWITCH
<u>6</u>	PRESSURE SWITCH
<u>7</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>1600</u>	FT. - 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>800</u>	FT. - RIGID CONDUIT - 1" D.
<u>8</u>	JUNCTION BOXES
<u>64</u>	PROGRAMMING POINTS
<u>300</u>	FT. POWER WIRING

Title	ECO-10 - ENCS ADDITIONS	Checked By	GSL	Date	9-17-93
	SUMMARY SHEET	Prepared By	GEL	Sheet No.	5-1
	Project	Job No.			



## BASELINE ENERGY USAGE

BLDG #

7262

HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4) ^\circ \text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290 ^\circ \text{F-DAY}) \left(4 \times 10^6 \frac{\text{BTU}}{\text{HR}}\right)}{(0.65) (68 - 4) ^\circ \text{F}} (0.6)$$

$$\text{ENERGY} = \underline{5940 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

AUXILIARY EQUIPMENT:

$$\text{FANS: ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{6 @ 10 \text{ EA.}} * 2545 * \underline{1.0} * 4369 = \underline{667 \times 10^6 \text{ BTU}} \frac{\text{YR}}{\text{(ELEC)}}$$

$$\text{PUMPS: ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HTG HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{7.5} * 2545 * \underline{1.0} * 4369 = \underline{83 \times 10^6 \text{ BTU}} \frac{\text{YR}}{\text{(ELEC)}}$$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{6690 \times 10^6 \text{ BTU}} \frac{\text{YR}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS BASELINE ENERGY USAGE	Checked By	Date
		GBL	9-16-93
Project	FT. CAMPBELL ENERGY SAVINGS PROFESSIONAL SERVICES	Prepared By	Sheet No.
		GBL	B-1
		Job No.	93-001-01

## BASELINE ENERGY USAGE

BLDG #  
7262

### COOLING - BIN METHOD

1 AHU @ 65,000  $\frac{\text{BTU}}{\text{HR}}$

<u>BIN</u>	<u>HRS/YR</u>	<u>% FULL LOAD</u>	<u>FULL LOAD BTU/HR</u>	<u>BTU YR</u>
95/99	3	* 1.0	* 65,000	= <u>195,000</u>
90/94	17	* 1.0	* 65,000	= <u>1,105,000</u>
85/89	75	* 0.85	* 65,000	= <u>4,144,000</u>
80/84	185	* 0.70	* 65,000	= <u>8,417,000</u>
75/79	407	* 0.55	* 65,000	= <u>14,550,000</u>
70/74	714	* 0.40	* 65,000	= <u>18,564,000</u>
65/69	673	* 0.25	* 65,000	= <u>10,936,000</u>

TOTAL  
HRS/YR = 2074

TOTAL  $\frac{\text{BTU}}{\text{YR}} = 57.9 \times 10^6$

$$\begin{aligned} \text{TOTAL ELECTRICAL ENERGY INPUT COOLING} &= \frac{58 \times 10^6 \frac{\text{BTU}}{\text{YR}}}{2} \left( \frac{\text{AVG.}}{\text{C.O.P.}} \right) \\ &= \underline{29 \times 10^6 \text{ BTU/YR (ELEC)}} \end{aligned}$$

NOTE : HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 8 A.M.

### AUXILIARIES :

1 FAN @ 10; 1 @ 5 HP

$$\text{FANS : } 15 \text{ HP} \times 2545 \frac{\text{BTU}}{\text{HP HR}} \times 1.0 \times 2074 = \underline{79 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}}$$

FOR THE HOURS FROM 5 P.M. TO 8 A.M.:

$$\begin{aligned} \text{TOTAL BASELINE COOLING ENERGY} &= \underline{108 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}} \\ \text{THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS} & \\ \text{FOR IMPLEMENTING THIS ECO} & \end{aligned}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	
	BASELINE COOLING ENERGY	Prepared By	GBL	9-21-93	
	Project	Job No.		Sheet No.	2-0

## PROPOSED ENERGY USAGE

BLOG#  
7262

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED  
HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM  
(EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(4 \times 10^6) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 2.9 \times 10^6 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right) (0.6)}{2 (68 - 4)^{\circ}\text{F}} + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) \left( \frac{\text{BASELINE HEATING ENERGY}}{\text{DAY}} \right)}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 (2.9 \times 10^6 \frac{\text{BTU}}{\text{HR}}) (0.6)}{(0.45) (64)} + \frac{(24 - 12) (5940 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 5123 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE AUX. ENERGY} - \text{PROPOSED AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = 750 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \frac{\text{FROM SHEET F-1}}{\text{YE}} \right) - \left[ 67.5 \text{ HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACTIL}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 300 \times 10^6 \frac{\text{BTU}}{\text{YR}} \quad \text{TOTAL ENERGY SAVINGS} = 1117 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
	PROPOSED ENERGY USAGE	Prepared By	GBL	Sheet No.	
Project	FT. CAMPBELL ENERGY SAVINGS	Job No.			

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 17:32:35

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 7262

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-298  
PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

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DETAILED ESTIMATE	DETAIL PAGE
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AA. ELECTRICAL.....	1

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Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7262  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 17:32:35

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100	800.00 LF EELEF			62	1,874	8	720	36	2,638
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION	0.30 MLF EELEF			2	52	0	16	1	69
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100	8.00 EA EELEB			5	176	1	39	2	218
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100	1.60 MLF EELEF			13	400	2	1,312	66	1,779
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100	8.00 EA EELEB			40	1,320	5	480	24	1,830
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100	8.00 EA EELEB			10	330	1	160	8	499
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100	7.00 EA EELEB			9	289	1	595	30	915
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100	6.00 EA EELEB			15	495	2	240	12	749
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100	18.00 EA EESMA			36	1,130	25	810	41	2,006
CD=3 EL 3003 OUTSIDE AIR TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	45.00	2.25	130.10
WC=1100	1.00 EA EELEB			3	83	0	45	2	130
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100	2.00 EA EPIPA			9	267	1	120	6	394

4-300

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7262  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 17:32:35

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTY	DIRECT \$
16961 4000 PRESSURE									
CD=3 EL 4002 DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100 SENSOR	6.00 EA EESMA			12	377	8	210	11	606
CD=3 EL 4003 PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100 SENSOR	1.00 EA EPIPA			9	267	1	85	4	357
16962 PRESSURE SWITCHES									
CD=3 EL 1001 PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100	6.00 EA EESMA			12	377	8	480	24	889
16963 FLOW SWITCHES									
CD=3 EL 1001 FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100	1.00 EA EELEB			3	83	0	190	10	282
CD=3 EL 1002 FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100	1.00 EA MSPFB			5	138	2	0	0	140
16991 5000 MUX									
CD=3 EL 5001 MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100	1.00 EA EELEB			5	165	1	4,720	236	5,122
16991 6000 CABINET									
CD=3 EL 6001 DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100	1.00 EA EELEB			3	83	0	350	18	450
CD=3 EL 6002 INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100	1.00 EA EELEB			3	83	0	125	6	214
16991 7000 SOFTWARE									
CD=3 EL 7001 PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100	64.00 EA EELEB			80	2,641	10	1,920	96	4,667
TOTAL DIVISION 16 ELECTRICAL				333	10,628	78	12,617	631	23,954
TOTAL FACILITY AA. ELECTRICAL				333	10,628	78	12,617	631	23,954
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				333	10,628	78	12,617	631	23,954
TOTAL BASE BID				333	10,628	78	12,617	631	23,954

CREW ID: ORL290

CURRENCY in DOLLARS

 PROJECT ID: 726210  
 4-301

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262  
2. SITEWORK /

TIME 17:32:35

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				333	10,628	78	12,617	631	23,954

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-302

PROJECT ID: 726210



Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

PROJECT NOTES

SUMMARY PAGE 1

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PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO  
SELECTED FACILITIES AT FORT CAMPBELL.

CREW ID: ORL290

CURRENCY in DOLLARS

4-303

PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER	FCR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%			
		1.00 EA	23,954	2,395	0	1,976	708	0		29,034	29034.15
BID ITEM TOTAL		1.00 EA	23,954	2,395	0	1,976	708	0		29,034	29034.15

CREW ID: ORL290

CURRENCY in DOLLARS

4-304

PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID		23,954	2,395	0	1,976	708	0	29,034	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		23,954	2,395	0	1,976	708	0	29,034	

CREW ID: ORL290

CURRENCY in DOLLARS

4-305

PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	29,034		29,034	29034.10
	TOTAL CURRENT CONTRACT COST			29,034	0	29,034	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			29,034	0	29,034	
	Government-Furnished Property			0		0	
	SUBTOTAL			29,034	0	29,034	
	Contingencies	10.0%		2,903	0	2,903	
	SUBTOTAL			31,938	0	31,938	
	SIOH (S&A)	5.0%		1,597	0	1,597	
	CURRENT WORKING ESTIMATE			33,534	0	33,534	
	Estimated Construction Time	365	Days				

CREW ID: ORL290

CURRENCY in DOLLARS

4-306  
PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT **	SUBCON	W/OH&P	SUBTOTAL
										AMOUNT PCT			
AA	GENERAL/PRIME		1.00	EA	333	10,628	78	13,248	23,954	100.0%	0		23,954
	TOTAL DIRECT				333	10,628	78	13,248	23,954	100.0%			

CREW ID: ORL290

CURRENCY in DOLLARS

4-307  
PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOFC%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		23,954	2,395	10.0%	0.0		1,976	7.5%	2.5%	0.0%		29,034	100.0%		29034.13
	TOTAL OVERHEAD & PROFIT			2,395	10.0%			1,976	7.5%							

CREW ID: ORL290

CURRENCY in DOLLARS

4-308  
PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	333	10,628	78	12,617	631	23,954
TOTAL DIRECT	333	10,628	78	12,617	631	23,954

4-309

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	333	10,628	78	12,617	631	23,954
TOTAL DIRECT	333	10,628	78	12,617	631	23,954

CREW ID: ORL290

CURRENCY in DOLLARS

4-310  
PROJECT ID: 726210



Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL	HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
EMI20 SMALL TOOLS									1.40	1.40	56	78
TOTAL PROJECT EQUIPMENT HOURS											56	78

4-311

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 726210

Wed 22 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7262

TIME 17:32:35

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTH	TXS/INS	FRNG	TRVL	HRLY -- RATE	UPB RATE	**** TOTAL HOURS	**** COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	290	9,354
LSHMT SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	30	896
LSPFI STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	13	376
TOTAL PROJECT MANHOURS								333	10,627

\* \* \* END OF SUMMARY REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-312  
PROJECT ID: 726210

## SUMMARY SHEET

BLOG #  
7264

$$\text{NATURAL GAS SAVINGS} = \frac{966}{\text{YR}} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{4.00}{\text{MBTU}} = \$ \underline{3864}$$

$$\text{ELECTRICAL SAVINGS} = \frac{402}{\text{YR}} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{6.19}{\text{MBTU}} = \$ \underline{2488}$$

$$\text{TOTAL SAVINGS} = \$ \underline{6352} / \text{YR}$$

### HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
<u>1</u>	FID/MUX
<u>1</u>	MUX ONLY
<u>8</u>	SPACE TEMP SENSOR
<u>18</u>	DUCT TEMP SENSOR
<u>2</u>	WATER TEMP SENSOR
<u>1</u>	D.A. TEMP SENSOR
<u>1</u>	HUMIDITY SENSOR
<u>11</u>	START/STOP
<u>11</u>	STATUS RELAY
<u>8</u>	DIFF. PRESSURE (DUCT)
<u>2</u>	DIFF. PRESSURE (PIPE)
<u>1</u>	FLOW SWITCH
<u>8</u>	PRESSURE SWITCH
<u>10</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>1200</u> FT.	- 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>600</u> FT.	- RIGID CONDUIT - 1" D.
<u>10</u>	JUNCTION BOXES
<u>300</u> FT	POWER WIRING
<u>68</u>	PROGRAMMING POINTS

Title ECO-10 - EMCS ADDITIONS  
SUMMARY SHEET

Checked By

GBL

Date

9-17-93

Prepared By

GBL

Sheet No.

Project FT. CAMPBELL ENERGY SAVINGS

Job No.

5-1

## BASELINE ENERGY USAGE

BLDG #

7264

### HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{Q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{Q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ\text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ\text{F-DAY}) \left(4.8 \times 10^6 \frac{\text{BTU}}{\text{HR}}\right)}{(0.65) (68 - 4)^\circ\text{F}} (0.6)$$

$$\text{ENERGY} = \underline{7128 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

### AUXILIARY EQUIPMENT:

2 @ 5, 6 @ 3

$$\text{FANS: ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{28} * 2545 * \underline{1.0} * 4369 = \underline{311 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

1 @ 3, 1 @ 2

$$\text{PUMPS: ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HRS}}{\text{YR}}$$

$$\text{ENERGY} = \underline{5} * 2545 * \underline{1.0} * 4369 = \underline{56 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{7495 \times 10^6} \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS BASELINE ENERGY USAGE	Checked By	Date
		GBL	9-16-93
Project	FT. CAMPBELL ENERGY SAVINGS	Prepared By	Sheet No.
		GBL	B-1
		Job No.	

## BASLINE ENERGY USAGE

BLDG #  
7264

### COOLING - BIN METHOD

<u>BIN</u>	<u>HRS/YR</u>		<u>% FULL LOAD</u>	<u>FULL LOAD BTU/HR</u>	<u>BTU/YR</u>
95/99	3	*	1.0	* 240,000	= <u>720,000</u>
90/94	17	*	1.0	* 240,000	= <u>4,080,000</u>
85/89	75	*	0.85	* 240,000	= <u>15,300,000</u>
80/84	185	*	0.70	* 240,000	= <u>31,080,000</u>
75/79	407	*	0.55	* 240,000	= <u>53,724,000</u>
70/74	714	*	0.40	* 240,000	= <u>68,544,000</u>
65/69	673	*	0.25	* 240,000	= <u>40,380,000</u>

TOTAL  
HRS/YR = 2074

TOTAL  $\frac{BTU}{YR} = \underline{213,828,000}$

$$\begin{aligned} \text{TOTAL ELECTRICAL ENERGY INPUT COOLING} &= \underline{213,828,000} \frac{BTU}{YR} \div 2 \text{ (AVG. C.O.P.)} \\ &= \underline{107 \times 10^6} \text{ BTU/YR (ELEC)} \end{aligned}$$

NOTE: HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 3 A.M.

### AUXILIARIES:

$$\text{FANS: } \underline{28} \text{ HP} \approx 2545 \frac{BTU}{HP \cdot HR} \times 1.0 \times 2074 = \underline{148 \times 10^6} \frac{BTU}{YR} \text{ (ELEC)}$$

FOR THE HOURS FROM 5 P.M. TO 3 A.M.:

$$\begin{aligned} \text{TOTAL BASELINE COOLING ENERGY} &= \underline{255 \times 10^6} \frac{BTU}{YR} \text{ (ELEC)} \\ \text{THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS} & \\ \text{FOR IMPLEMENTING THIS ECO} & \end{aligned}$$

Title ECO-10 - EMCS ADDITIONS BASELINE COOLING ENERGY	Checked By GBL	Date 7-21-93
Project FORT CAMPBELL ENERGY SAVINGS	Prepared By GBL	Sheet No.
Job No.		4-315

## PROPOSED ENERGY USAGE

BLDG #  
7264

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED  
HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM  
(EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(4.8 \times 10^6) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 3.5 \times 10^6 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right)}{n (68 - 4)^{\circ}\text{F}} (0.6) + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 \left( 3.5 \times 10^6 \frac{\text{BTU}}{\text{HR}} \right)}{(0.65) (64)} (0.6) + \frac{(24 - 12) (7123 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 6162 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE AUX. ENERGY} - \text{PROPOSED AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = 36.7 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ 33 \text{ HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACTOR}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 147 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC}) \quad \text{TOTAL ENERGY SAVINGS} = 1113 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
	PROPOSED ENERGY USAGE	Prepared By	GBL	Sheet No.	
Project	FT. CAMPBELL ENERGY SAVINGS	Job No.			

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 12:32:25

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 7264

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-317  
PROJECT ID: 726410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

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DETAILED ESTIMATE	DETAIL PAGE
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AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7264  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:32:25

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100	600.00 LF EELEF			47	1,405	6	540	27	1,979
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION	0.30 MLF EELEF			2	52	0	16	1	69
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100	10.00 EA EELEB			7	220	1	49	2	272
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100	1.20 MLF EELEF			10	300	1	984	49	1,334
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100	11.00 EA EELEB			55	1,816	7	660	33	2,516
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100	11.00 EA EELEB			14	454	2	220	11	687
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100	10.00 EA EELEB			13	413	2	850	43	1,307
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100	8.00 EA EELEB			20	660	3	320	16	999
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100	18.00 EA EESMA			36	1,130	25	810	41	2,006
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100	2.00 EA EPIPA			9	267	1	120	6	394

CREW ID: ORL290

CURRENCY in DOLLARS

4-319

PROJECT ID: 726410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7264  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:32:25

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE										
CD=3 EL 4002	DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100	SENSOR	8.00 EA EESMA		16	502	11	280	14		808
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	2.00 EA EPIPA		17	535	1	170	9		715
16962 PRESSURE SWITCHES										
CD=3 EL 1001	PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100		8.00 EA EESMA		16	502	11	640	32		1,186
16963 FLOW SWITCHES										
CD=3 EL 1001	FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100		1.00 EA EELEB		3	83	0	190	10		282
CD=3 EL 1002	FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100		1.00 EA MSPFB		5	138	2	0	0		140
16991 5000 MUX										
CD=3 EL 5001	MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100		1.00 EA EELEB		5	165	1	4,720	236		5,122
16991 6000 CABINET										
CD=3 EL 6001	DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100		1.00 EA EELEB		3	83	0	350	18		450
CD=3 EL 6002	INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100		1.00 EA EELEB		3	83	0	125	6		214
16991 7000 SOFTWARE										
CD=3 EL 7001	PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100		68.00 EA EELEB		85	2,806	11	2,040	102		4,959
TOTAL DIVISION 16 ELECTRICAL					362	11,613	86	13,084	654	25,437
TOTAL FACILITY AA. ELECTRICAL					362	11,613	86	13,084	654	25,437
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					362	11,613	86	13,084	654	25,437
TOTAL BASE BID					362	11,613	86	13,084	654	25,437

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 726410  
4-320

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264  
2. SITEWORK /

TIME 12:32:25

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				362	11,613	86	13,084	654	25,437

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-321  
PROJECT ID: 726410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

PROJECT NOTES

SUMMARY PAGE 1

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PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	25,437	2,544	0	2,099	752	0	30,831	30830.85
BID ITEM TOTAL		1.00 EA	25,437	2,544	0	2,099	752	0	30,831	30830.85

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	25,437	2,544	0	2,099	752	0	30,831	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	25,437	2,544	0	2,099	752	0	30,831	

4-324

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 726410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7264

TIME 12:32:25

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	30,831		30,831	30830.80
	TOTAL CURRENT CONTRACT COST			30,831	0	30,831	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			30,831	0	30,831	
	Government-Furnished Property			0		0	
	SUBTOTAL			30,831	0	30,831	
	Contingencies	10.0%		3,083	0	3,083	
	SUBTOTAL			33,914	0	33,914	
	SIOH (S&A)	5.0%		1,696	0	1,696	
	CURRENT WORKING ESTIMATE			35,610	0	35,610	
	Estimated Construction Time	365	Days				

CREW ID: ORL290

CURRENCY in DOLLARS

4-325  
 PROJECT ID: 726410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PH	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	362	11,613	86	13,738	25,437	100.0%	0	25,437
	TOTAL DIRECT				362	11,613	86	13,738	25,437	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

4-326

PROJECT ID: 726410



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOFC%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		25,437	2,544	10.0%	0.0		2,099	7.5%	2.5%	0.0%		30,831	100.0%		30830.83
	TOTAL OVERHEAD & PROFIT			2,544	10.0%			2,099	7.5%							

CREW ID: ORL290

CURRENCY in DOLLARS

4-327

PROJECT ID: 726410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	362	11,613	86	13,084	654	25,437
TOTAL DIRECT	362	11,613	86	13,084	654	25,437

CREW ID: ORL290

CURRENCY in DOLLARS

4-328  
PROJECT ID: 726410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	362	11,613	86	13,084	654	25,437
TOTAL DIRECT	362	11,613	86	13,084	654	25,437

CREW ID: ORL290

CURRENCY in DOLLARS

4-329  
PROJECT ID: 726410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	UPB	HOURS	TOTAL	COST
EMI20 SMALL TOOLS								1.40	1.40	61		86
TOTAL PROJECT EQUIPMENT HOURS										61		86

4-330

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 726410

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7264

TIME 12:32:25

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	311	10,101
LSHMT	SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	34	1,016
LSPFI	STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	17	496
TOTAL PROJECT MANHOURS									362	11,612

\* \* \* END OF SUMMARY REPORT \* \* \*

## SUMMARY SHEET

BLOG #  
7268

$$\text{NATURAL GAS SAVINGS} = \frac{832 \text{ MBTU}}{\text{YR}} \times \$4.00 = \$3328$$

$$\text{ELECTRICAL SAVINGS} = \frac{405 \text{ MBTU}}{\text{YR}} \times \$6.19 = \$2507$$

$$\text{TOTAL SAVINGS} = \$5835 / \text{YR}$$

### HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
—	FID/MUX
<u>1</u>	MUX ONLY
<u>8</u>	SPACE TEMP SENSOR
<u>18</u>	DUCT TEMP SENSOR
<u>2</u>	WATER TEMP SENSOR
—	D.A. TEMP SENSOR
—	HUMIDITY SENSOR
<u>11</u>	START/STOP
<u>11</u>	STATUS RELAY
<u>8</u>	DIFF. PRESSURE (DUCT)
<u>2</u>	DIFF. PRESSURE (PIPE)
<u>1</u>	FLOW SWITCH
<u>8</u>	PRESSURE SWITCH
<u>10</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>1200</u> FT.	— 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>600</u> FT.	— RIGID CONDUIT - 1" D.
<u>10</u>	JUNCTION BOXES
<u>68</u>	PROGRAMMING POINTS
<u>300</u> FT	— POWER WIRING

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-17-93
	SUMMARY SHEET	Prepared By	GEL	Sheet No.	
	Project	Job No.	92001 01		C-1
	FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY STUDY				

## BASELINE ENERGY USAGE

BLDG #

7268

### HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ\text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ\text{F-DAY}) \left(4 \times 10^6 \frac{\text{BTU}}{\text{HR}}\right)}{(0.45) (68 - 4)^\circ\text{F}} (0.6)$$

$$\text{ENERGY} = 5940 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

### AUXILIARY EQUIPMENT:

2@5 6@3

$$\text{FANS: ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = 28 * 2545 * 1.0 * 4369 = 311 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

PUMPS: 1@5, 1@3/4

$$\text{ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HRS}}{\text{YR}}$$

$$\text{ENERGY} = 5.75 * 2545 * 1.0 * 4369 = 64 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$$

$$\text{TOTAL BASELINE HEATING ENERGY} = 6315 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title

ECO-10 - EMCS ADDITIONS  
BASELINE ENERGY USAGE

Checked By

GBL

Date

7-16-93

Prepared By

GBL

Sheet No.

B-1

Project

FT. CAMPBELL ENERGY SAVINGS  
OPPORTUNITY SURVEY

Job No.

92001 01

4-333

## BASLINE ENERGY USAGE

BLDG #  
7268

### COOLING - BIN METHOD

20 TONS DX

<u>BIN</u>	<u>HRS/YR</u>	<u>% FULL LOAD</u>	<u>FULL LOAD BTU/HR</u>	<u>BTU/YR</u>
95/99	3	* 1.0	* 240,000	= 720,000
90/94	17	* 1.0	* 240,000	= 4,080,000
85/89	75	* 0.85	* 240,000	= 15,300,000
80/84	185	* 0.70	* 240,000	= 31,080,000
75/79	407	* 0.55	* 240,000	= 53,724,000
70/74	714	* 0.40	* 240,000	= 68,544,000
65/69	673	* 0.25	* 240,000	= 40,380,000

TOTAL  
HRS/YR = 2074

TOTAL BTU/YR = 213,828,000

$$\text{TOTAL ELECTRICAL ENERGY INPUT COOLING} = \frac{213,828,000 \text{ BTU}}{\text{YR}} \div 2 \left( \frac{\text{AVG. C.O.P.}}{\text{C.O.P.}} \right)$$

$$= 107 \times 10^6 \text{ BTU/YR (ELEC)}$$

NOTE: HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 3 A.M.

### AUXILIARIES:

2 @ 5, 6 @ 3

FANS:  $\frac{28 \text{ HP} \times 2545 \text{ BTU}}{\text{HP HR}} \times 1.0 \times 2074 = 148 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$

FOR THE HOURS FROM 5 P.M. TO 3 A.M.

TOTAL BASELINE COOLING ENERGY =  $\frac{255 \times 10^6 \text{ BTU}}{\text{YR}} \text{ (ELEC)}$

THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS FOR IMPLEMENTING THIS ECO

Title	ECO-10 - EMCS ADDITIONS	Checked By	GDL	Date	9-21-93
	BASLINE COOLING ENERGY	Prepared By	GDL	Sheet No.	
Project	PORT CAMPBELL ENERGY SAVINGS	Job No.	23001	2-7	



## PROPOSED ENERGY USAGE

BLDG #  
7268

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(4.0 \times 10^6) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 2.88 \times 10^6 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right)}{n (68 - 4)^{\circ}\text{F}} (0.6) + \frac{\left( 24 - \frac{\text{SETBACK HRS}}{\text{DAY}} \right) \left( \frac{\text{BASELINE HEATING ENERGY}}{\text{DAY}} \right)}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 (2.88 \times 10^6 \frac{\text{BTU}}{\text{HR}})}{(0.45) (64)} (0.6) + \frac{(24 - 12) (5940 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 5108 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE AUX. ENERGY} - \text{PROPOSED AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = 375 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ 33.75 \text{ HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACT}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 150 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)} \quad \text{TOTAL ENERGY SAVINGS} = 982 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
	PROPOSED ENERGY USAGE	Prepared By	GBL	Sheet No.	
Project	FT. CAMPBELL ENERGY SAVINGS	Job No.	92000001		
	OPPORTUNITY SAVED			E-1	

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 12:42:47

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 7268

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-336  
PROJECT ID: 726810

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7268  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:42:47

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100	600.00 LF EELEF			47	1,405	6	540	27	1,979
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION	0.30 MLF EELEF			2	52	0	16	1	69
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100	10.00 EA EELEB			7	220	1	49	2	272
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100	1.20 MLF EELEF			10	300	1	984	49	1,334
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100	11.00 EA EELEB			55	1,816	7	660	33	2,516
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100	11.00 EA EELEB			14	454	2	220	11	687
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100	10.00 EA EELEB			13	413	2	850	43	1,307
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100	8.00 EA EELEB			20	660	3	320	16	999
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100	18.00 EA EESMA			36	1,130	25	810	41	2,006
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100	2.00 EA EPIPA			9	267	1	120	6	394

4-338

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 726810

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7268  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:42:47

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE										
CD=3 EL 4002	DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100	SENSOR	8.00 EA EESMA		16	502		11	280	14	808
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	2.00 EA EPIPA		17	535		1	170	9	715
16962 PRESSURE SWITCHES										
CD=3 EL 1001	PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100		8.00 EA EESMA		16	502		11	640	32	1,186
16963 FLOW SWITCHES										
CD=3 EL 1001	FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100		1.00 EA EELEB		3	83		0	190	10	282
CD=3 EL 1002	FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100		1.00 EA MSPFB		5	138		2	0	0	140
16991 5000 MUX										
CD=3 EL 5001	MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100		1.00 EA EELEB		5	165		1	4,720	236	5,122
16991 6000 CABINET										
CD=3 EL 6001	DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100		1.00 EA EELEB		3	83		0	350	18	450
CD=3 EL 6002	INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100		1.00 EA EELEB		3	83		0	125	6	214
16991 7000 SOFTWARE										
CD=3 EL 7001	PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100		68.00 EA EELEB		85	2,806		11	2,040	102	4,959
TOTAL DIVISION 16 ELECTRICAL					362	11,613	86	13,084	654	25,437
TOTAL FACILITY AA. ELECTRICAL					362	11,613	86	13,084	654	25,437
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					362	11,613	86	13,084	654	25,437
TOTAL BASE BID					362	11,613	86	13,084	654	25,437
CREW ID: ORL290					CURRENCY in DOLLARS				PROJECT ID: 726810 4-339	

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268  
2. SITEWORK /

TIME 12:42:47

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				362	11,613	86	13,084	654	25,437

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

4-340

PROJECT ID: 726810

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL	1.00 EA	25,437	10.0% 2,544	0.0% 0	7.5% 2,099	2.5% 752	0.0% 0	30,831	30830.85
BID ITEM TOTAL		1.00 EA	25,437	2,544	0	2,099	752	0	30,831	30830.85

CREW ID: ORL290

CURRENCY in DOLLARS

4-342

PROJECT ID: 726810



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	25,437	2,544	0	2,099	752	0	30,831	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	25,437	2,544	0	2,099	752	0	30,831	

CREW ID: ORL290

CURRENCY in DOLLARS

4-343

PROJECT ID: 726810

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	30,831		30,831	30830.80
TOTAL CURRENT CONTRACT COST				30,831	0	30,831	
Cost Growth from 09/93 to 09/94 Index Values: 0000 0000		0.0%		0	0	0	
ESCALATED CONTRACT COST				30,831	0	30,831	
Government-Furnished Property				0		0	
SUBTOTAL				30,831	0	30,831	
Contingencies		10.0%		3,083	0	3,083	
SUBTOTAL				33,914	0	33,914	
SIOH (S&A)		5.0%		1,696	0	1,696	
CURRENT WORKING ESTIMATE				35,610	0	35,610	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

4-344  
PROJECT ID: 726810

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	362	11,613	86	13,738		25,437	100.0%	0	25,437
	TOTAL DIRECT				362	11,613	86	13,738		25,437	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

4-345  
PROJECT ID: 726810

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOFC%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHR%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		25,437	2,544	10.0%	0.0		2,099	7.5%	2.5%	0.0%		30,831	100.0%		30830.83
	TOTAL OVERHEAD & PROFIT			2,544	10.0%			2,099	7.5%							

CREW ID: ORL290

CURRENCY in DOLLARS

4-346

PROJECT ID: 726810

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	362	11,613	86	13,084	654	25,437
TOTAL DIRECT	362	11,613	86	13,084	654	25,437

CREW ID: ORL290

CURRENCY in DOLLARS

4-347  
PROJECT ID: 726810

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	362	11,613	86	13,084	654	25,437
TOTAL DIRECT	362	11,613	86	13,084	654	25,437

4-348

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 726810

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

EQUIPMENT SUMMARY

SUMMARY PAGE 9

----- *** BOOK VALUE *** ADJ FACTOR ADJUSTD BOOK OP -- HRLY --- UPB **** TOTAL ****												
EQUIP DESCRIPTION	LIFE HRS	TL	HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
EMI20 SMALL TOOLS									1.40	1.40	61	86
TOTAL PROJECT EQUIPMENT HOURS											61	86

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7268

TIME 12:42:47

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	311	10,101
LSHMT	SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	34	1,016
LSPFI	STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	17	496
									362	11,612
TOTAL PROJECT MANHOURS										

\* \* \* END OF SUMMARY REPORT \* \* \*

4-350

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 726810



## SUMMARY SHEET

BLOG #

7272

$$\text{NATURAL GAS SAVINGS} = \underline{594} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{4.00}{\text{MBTU}} = \$ \underline{2376}$$

$$\text{ELECTRICAL SAVINGS} = \underline{202} \frac{\text{MBTU}}{\text{YR}} * \$ \frac{6.19}{\text{MBTU}} = \$ \underline{1250}$$

$$\text{TOTAL SAVINGS} = \$ \underline{3626} / \text{YR}$$

### HARDWARE REQUIRED:

<u>QUANTITY</u>	<u>ITEM</u>
<u>1</u>	FID/MUX
<u>1</u>	MUX ONLY
<u>3</u>	SPACE TEMP SENSOR
<u>2</u>	DUCT TEMP SENSOR
<u>1</u>	WATER TEMP SENSOR
<u>1</u>	D.A. TEMP SENSOR
<u>4</u>	HUMIDITY SENSOR
<u>4</u>	START/STOP
<u>1</u>	STATUS RELAY
<u>2</u>	DIFF. PRESSURE (DUCT)
<u>1</u>	DIFF. PRESSURE (PIPE)
<u>1</u>	FLOW SWITCH
<u>1</u>	PRESSURE SWITCH
<u>3</u>	CURRENT RELAY
<u>1</u>	DATA TERMINAL CABINET
<u>1</u>	INSTRUMENT ENCLOSURE
<u>800</u> FT.	- 2 WIRE, TWISTED PAIR, #18 CONTROL WIRE
<u>400</u> FT.	- RIGID CONDUIT - 1" D.
<u>5</u>	JUNCTION BOXES
<u>20</u>	PROGRAMMING POINTS
<u>100</u> FT.	POWER WIRING

Title ECO-10 - EMCS ADDITIONS  
SUMMARY SHEET

Checked By GBL

Date 9-17-93

Project FT. CAMPBELL ENERGY SAVINGS  
OPPORTUNITY STUDY

Prepared By GBL

Sheet No.

Job No. 92001 01

5-1

## BASELINE ENERGY USAGE

BLDG #

7272

HEATING: DEGREE DAY METHOD

$$\text{HEATING ENERGY (BTU/YR)} = \frac{24 * DD * \dot{q}}{\eta * \Delta T} * C_D$$

WHERE: DD = DEGREE DAYS - °F-DAY

$\dot{q}$  = BUILDING DESIGN HEAT LOAD - BTU/HR

$\eta$  = HEATING SYSTEM EFFICIENCY

$\Delta T = (T_{\text{INDOORS}} - T_{\text{OUTSIDE}})_{\text{DESIGN}} = (68 - 4)^\circ\text{F}$

$C_D$  = CORRECTION FACTOR BASED ON 65° DD

$$\text{HEATING ENERGY} = \frac{\left(24 \frac{\text{HR}}{\text{DAY}}\right) (4290^\circ\text{F-DAY}) \left(3 \times 10^6 \frac{\text{BTU}}{\text{HR}}\right)}{(0.65) (68 - 4)^\circ\text{F}} (0.6)$$

$$\text{ENERGY} = \underline{4455 \times 10^6} \frac{\text{BTU}}{\text{YR}} \text{ (NATURAL GAS)}$$

AUXILIARY EQUIPMENT:

$$\text{FANS: ENERGY} = \text{FAN HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = \frac{1 @ 10}{1 @ 5} * 2545 * 1.0 * 4369 = \underline{16.7 \times 10^6 \frac{\text{BTU}}{\text{YR}}} \text{ (ELEC)}$$

$$\text{PUMPS: ENERGY} = \text{PUMP HP} * 2545 \frac{\text{BTU}}{\text{HR} \cdot \text{HP}} * \text{DIVERSITY FACTOR} * \frac{\text{HEATING HRS}}{\text{YR}}$$

$$\text{ENERGY} = \frac{1 @ 3}{1 @ 3/4} * 2545 * 1.0 * 4369 = \underline{4.7 \times 10^6 \frac{\text{BTU}}{\text{YR}}} \text{ (ELEC)}$$

$$\text{TOTAL BASELINE HEATING ENERGY} = \underline{4664 \times 10^6 \frac{\text{BTU}}{\text{YR}}}$$

Title	ECO-10 - EMCS ADDITIONS BASELINE ENERGY USAGE	Checked By	Date 9-16-93
		Prepared By	
Project	FT. CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY	Job No.	Sheet No. B-1
		93006.01	

## BASELINE ENERGY USAGE

BLDG #  
7272

COOLING - BIN METHOD 1 AHU @ 87,000  $\frac{\text{BTU}}{\text{HR}}$

<u>BIN</u>	<u>HRS/YR</u>		<u>% FULL LOAD</u>	<u>FULL LOAD BTU/HR</u>	<u><math>\frac{\text{BTU}}{\text{YR}}</math></u>
95/99	3	*	1.0	* 87,000	= <u>261,000</u>
90/94	17	*	1.0	* 87,000	= <u>1,479,000</u>
85/89	75	*	0.85	* 87,000	= <u>5,546,000</u>
80/84	185	*	0.70	* 87,000	= <u>11,267,000</u>
75/79	407	*	0.55	* 87,000	= <u>19,475,000</u>
70/74	714	*	0.40	* 87,000	= <u>24,847,000</u>
65/69	673	*	0.25	* 87,000	= <u>14,638,000</u>

TOTAL  
HRS/YR = 2074

TOTAL  $\frac{\text{BTU}}{\text{YR}} = 77.5 \times 10^6$

TOTAL ELECTRICAL ENERGY INPUT COOLING =  $77.5 \times 10^6 \frac{\text{BTU}}{\text{YR}} \div 2 \text{ (AVG. C.O.P.)}$   
=  $39 \times 10^6 \text{ BTU/YR (ELEC)}$

NOTE : HRS/YR INDICATE THE TOTAL ANNUAL OCCURRENCES IN EACH BIN FOR THE HOURS FROM 5 P.M. TO 8 A.M.

### AUXILIARIES :

1 AHU @ 10 RETURN FAN @ 5

FANS : 15 HP \*  $2545 \frac{\text{BTU}}{\text{HP HR}} * 1.0 * 2074 = 79 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$

FOR THE HOURS FROM 5 P.M. TO 8 A.M.

TOTAL BASELINE COOLING ENERGY =  $118 \times 10^6 \frac{\text{BTU}}{\text{YR}} \text{ (ELEC)}$   
THIS IS ALSO THE PROPOSED COOLING ENERGY SAVINGS  
FOR IMPLEMENTING THIS ECO

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-21-93
	BASELINE COOLING ENERGY	Prepared By	GBL		
	Project	Job No.	2-7	Sheet No.	4-353

## PROPOSED ENERGY USAGE

BLDG #

7272

### HEATING: DEGREE DAY METHOD

SEE SHEET (B-1) FOR DEGREE DAY FORMULA EXPLANATION.  
BY LOWERING SPACE HEATING SETPOINTS DURING UNOCCUPIED  
HOURS WITH THE ENERGY MANAGEMENT AND CONTROL SYSTEM  
(EMCS), THE FOLLOWING SAVINGS ARE ACHIEVED:

$$\text{EXISTING DESIGN } \Delta T = (68 - 4) = 4^{\circ}\text{F}$$

$$\text{PROPOSED SETBACK } \Delta T = (50 - 4) = 46^{\circ}\text{F}$$

$$\begin{aligned} \text{SETBACK BUILDING HEAT LOAD} &= \frac{\text{DESIGN HEAT LOAD}}{\text{DESIGN } \Delta T} * \text{PROPOSED } \Delta T \\ &= \frac{(3 \times 10^6) \frac{\text{BTU}}{\text{HR}}}{(68 - 4)^{\circ}\text{F}} * (50 - 4)^{\circ}\text{F} \end{aligned}$$

$$\text{SETBACK BUILDING HEAT LOAD} = 2.2 \times 10^6 \frac{\text{BTU}}{\text{HR}}$$

NOW USING THE DEGREE-DAY FORMULA FOR THE PROPOSED SETBACK CONDITION:

$$\begin{aligned} \text{PROPOSED HEATING ENERGY USAGE} &= \frac{\left( \frac{\text{SETBACK HRS}}{\text{DAY}} \right) (4290^{\circ}\text{F-DAY}) \left( \frac{\text{SETBACK BUILDING HT. LOAD}}{\text{HT. LOAD}} \right) (0.6)}{24 \frac{\text{HR}}{\text{DAY}}} + \frac{\left( \frac{24 - \text{SETBACK HRS}}{\text{DAY}} \right) (\text{BASELINE HEATING ENERGY})}{24 \frac{\text{HR}}{\text{DAY}}} \\ &= \frac{(12 \text{ HRS}) 4290 \left( 2.2 \times 10^6 \frac{\text{BTU}}{\text{HR}} \right) (0.6)}{(0.45) (64)} + \frac{(24 - 12) (4455 \times 10^6)}{24} \end{aligned}$$

$$\text{PROPOSED HEATING ENERGY USAGE} = 3861 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{NATURAL GAS})$$

$$\text{AUXILIARY ENERGY SAVINGS} = \text{BASELINE AUX. ENERGY} - \text{PROPOSED AUX. ENERGY}$$

$$\text{AUX. ENRG. SAVINGS} = 209 \times 10^6 \frac{\text{BTU}}{\text{YR}} \left( \text{FROM SHEET B-1} \right) - \left[ 18 \frac{3}{4} \text{HP} * 2545 * 0.6 \left( \frac{\text{DIV. FACTOR}}{\text{FACTUAL}} \right) * 4369 \right]$$

$$\text{AUX. ENERGY SAVINGS} = 84 \times 10^6 \frac{\text{BTU}}{\text{YR}} (\text{ELEC}) \quad \text{TOTAL ENERGY SAVINGS} = 678 \times 10^6 \frac{\text{BTU}}{\text{YR}}$$

Title	ECO-10 - EMCS ADDITIONS	Checked By	GBL	Date	9-16-93
	PROPOSED ENERGY USAGE	Prepared By	GBL	Sheet No.	F-1
Project	FT. CAMPBELL ENERGY SAVINGS	Job No.	27-11-1		

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 13:01:05

TITLE PAGE

---

ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-10: BUILDING 7272

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
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by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

4-355  
PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS H-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7272  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 13:01:05

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1121 1 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.08	2.34	0.01	0.90	0.05	3.30
WC=1100	400.00 LF EELEF			31	937	4	360	18	1,319
16120 1200 SINGLE STRANDED CONDUCTOR									
CD=4 EL 1211 NO. 12 AWG - TYPE THHN	*** UNIT COSTS: ***			5.78	174.30	0.78	52.98	2.65	230.71
WC=1100 INSULATION	0.10 MLF EELEF			1	17	0	5	0	23
16130 1200 NEMA 1 SCREW COVER ENCL									
CD=4 EL 1202 6X6X4 NEMA 1	*** UNIT COSTS: ***			0.67	22.01	0.09	4.87	0.24	27.21
WC=1100	5.00 EA EELEB			3	110	0	24	1	136
16900 CONTROLS AND INSTRUMENTATION									
16920 2000 CONTROL CABLE									
CD=3 EL 2001 TWISTED PAIR WIRES 18 AWG	*** UNIT COSTS: ***			8.28	249.82	1.12	820.00	41.00	1111.94
WC=1100	0.80 MLF EELEF			7	200	1	656	33	890
16920 3000 CONTROL SWITCH									
CD=3 EL 3001 START/STOP	*** UNIT COSTS: ***			5.00	165.05	0.65	60.00	3.00	228.70
WC=1100	4.00 EA EELEB			20	660	3	240	12	915
16920 4000 RELAY									
CD=3 EL 4001 STATUS RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	20.00	1.00	62.42
WC=1100	4.00 EA EELEB			5	165	1	80	4	250
CD=3 EL 4002 CURRENT RELAY	*** UNIT COSTS: ***			1.25	41.26	0.16	85.00	4.25	130.67
WC=1100	3.00 EA EELEB			4	124	0	255	13	392
16961 3000 TEMPERATURE									
CD=3 EL 3001 SPACE TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	40.00	2.00	124.85
WC=1100	1.00 EA EELEB			3	83	0	40	2	125
CD=3 EL 3002 DUCT TEMPERATURE SENSOR	*** UNIT COSTS: ***			2.00	62.79	1.40	45.00	2.25	111.44
WC=1100	3.00 EA EESMA			6	188	4	135	7	334
CD=3 EL 3004 PIPE TEMPERATURE SENSOR	*** UNIT COSTS: ***			4.25	133.71	0.32	60.00	3.00	197.03
WC=1100	2.00 EA EPIPA			9	267	1	120	6	394

CREW ID: ORL290

CURRENCY in DOLLARS

4-357  
 PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7272  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 13:01:05

DETAILED ESTIMATE

DETAIL PAGE 2

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16961 4000 PRESSURE										
CD=3 EL 4002	DUCT DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			2.00	62.79	1.40	35.00	1.75	100.94
WC=1100	SENSOR	1.00 EA EESMA		2	63		1	35	2	101
CD=3 EL 4003	PUMP DIFFERENTIAL PRESSURE	*** UNIT COSTS: ***			8.50	267.42	0.65	85.00	4.25	357.31
WC=1100	SENSOR	2.00 EA EPIPA		17	535		1	170	9	715
16961 5000 HUMIDITY										
CD=3 EL 5001	SPACE HUMIDITY SENSOR	*** UNIT COSTS: ***			2.50	82.53	0.32	85.00	4.25	172.10
WC=1100		1.00 EA EELEB		3	83		0	85	4	172
16962 PRESSURE SWITCHES										
CD=3 EL 1001	PRESSURE SWITCH	*** UNIT COSTS: ***			2.00	62.79	1.40	80.00	4.00	148.19
WC=1100		1.00 EA EESMA		2	63		1	80	4	148
16963 FLOW SWITCHES										
CD=3 EL 1001	FLOW SWITCH	*** UNIT COSTS: ***			2.50	82.53	0.32	190.00	9.50	282.35
WC=1100		1.00 EA EELEB		3	83		0	190	10	282
CD=3 EL 1002	FLOW SWITCH	*** UNIT COSTS: ***			5.00	137.72	2.02	0.00	0.00	139.73
WC=1100		1.00 EA MSPFB		5	138		2	0	0	140
16991 5000 MUX										
CD=3 EL 5001	MUX	*** UNIT COSTS: ***			5.00	165.05	0.65	4720.00	236.00	5121.70
WC=1100		1.00 EA EELEB		5	165		1	4,720	236	5,122
16991 6000 CABINET										
CD=3 EL 6001	DATA TERMINAL CABINET	*** UNIT COSTS: ***			2.50	82.53	0.32	350.00	17.50	450.35
WC=1100		1.00 EA EELEB		3	83		0	350	18	450
CD=3 EL 6002	INSTRUMENT SHELTER	*** UNIT COSTS: ***			2.50	82.53	0.32	125.00	6.25	214.10
WC=1100		1.00 EA EELEB		3	83		0	125	6	214
16991 7000 SOFTWARE										
CD=3 EL 7001	PROGRAMMING POINTS FOR EMCS	*** UNIT COSTS: ***			1.25	41.26	0.16	30.00	1.50	72.92
WC=1100		20.00 EA EELEB		25	825		3	600	30	1,458
TOTAL DIVISION 16 ELECTRICAL					153	4,870	26	8,271	414	13,580
TOTAL FACILITY AA. ELECTRICAL					153	4,870	26	8,271	414	13,580

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 727210

4-358



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272  
1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 13:01:05

DETAILED ESTIMATE

DETAIL PAGE 3

BASE BID

DIVISION 16 ELECTRICAL

QUANTITY UOM CREW

MANHR

LABOR

EQUIPMENT

MATERIAL

SALESTX

DIRECT \$

TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE

153 4,870 26 8,271 414 13,580

TOTAL BASE BID

153 4,870 26 8,271 414 13,580

TOTAL ADDITIVE

0 0 0 0 0 0

TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY

153 4,870 26 8,271 414 13,580

\* \* \* END OF DETAIL REPORT \* \* \*

4-359

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-10: EMCS EXPANSION

SCOPE OF WORK: EVALUATE THE EXPANSION OF THE EXISTING EMCS SYSTEM TO SELECTED  
FACILITIES AT FORT CAMPBELL.

CREW ID: ORL290

CURRENCY in DOLLARS

4-360

PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	13,580	1,358	0	1,120	401	0	16,460	16459.80
BID ITEM TOTAL		1.00 EA	13,580	1,358	0	1,120	401	0	16,460	16459.80

CREW ID: ORL290

CURRENCY in DOLLARS

4-361

PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 3

BID ITEM 2 SITEWORK

BASE BID

ID FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
TOTAL BASE BID	13,580	1,358	0	1,120	401	0	16,460	
TOTAL ADDITIVE	0	0	0	0	0	0	0	
TOTAL INCL ADD	13,580	1,358	0	1,120	401	0	16,460	

CREW ID: ORL290

CURRENCY in DOLLARS

4-362  
PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-10: BUILDING 7272

TIME 13:01:05

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
	1. BUILDING TO THE 5 FOOT LINE	1.00 EA	16,460		16,460	16459.80
	TOTAL CURRENT CONTRACT COST		16,460	0	16,460	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%	0	0	0	
	ESCALATED CONTRACT COST		16,460	0	16,460	
	Government-Furnished Property		0		0	
	SUBTOTAL		16,460	0	16,460	
	Contingencies	10.0%	1,646	0	1,646	
	SUBTOTAL		18,106	0	18,106	
	SIOH (S&A)	5.0%	905	0	905	
	CURRENT WORKING ESTIMATE		19,011	0	19,011	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

4-363

PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PH	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	153	4,870	26	8,684		13,580	100.0%	0	13,580
	TOTAL DIRECT				153	4,870	26	8,684		13,580	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

4-364  
PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

ID	CONTRACTOR	PH	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOFC%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHR%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		13,580	1,358	10.0%	0.0		1,120	7.5%	2.5%	0.0%		16,460	100.0%		16459.77
	TOTAL OVERHEAD & PROFIT			1,358	10.0%			1,120	7.5%							

CREW ID: ORL290

CURRENCY in DOLLARS

4-365

PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	153	4,870	26	8,271	414	13,580
TOTAL DIRECT	153	4,870	26	8,271	414	13,580

4-366

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 727210



Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	153	4,870	26	8,271	414	13,580
TOTAL DIRECT	153	4,870	26	8,271	414	13,580

CREW ID: ORL290

CURRENCY in DOLLARS

4-367  
PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

EQUIPMENT SUMMARY

SUMMARY PAGE 9

----- *** BOOK VALUE *** ADJ FACTOR ADJUSTD BOOK OP -- HRLY --- UPB **** TOTAL ****											
EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTH	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
-----											
EMI20 SMALL TOOLS								1.40	1.40	18	26
										-----	-----
TOTAL PROJECT EQUIPMENT HOURS										18	26

4-368

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 727210

Fri 24 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-10: BUILDING 7272

TIME 13:01:05

LABOR SUMMARY

SUMMARY PAGE 10

CRAFT DESCRIPTION	BASE	OVERTH	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	131	4,224
LSHMT SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	5	149
LSPFI STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	17	496
TOTAL PROJECT MANHOURS								153	4,869

\* \* \* END OF SUMMARY REPORT \* \* \*

## DEFINITE PURPOSE A-C V★S DRIVES VVI 5-150 HP

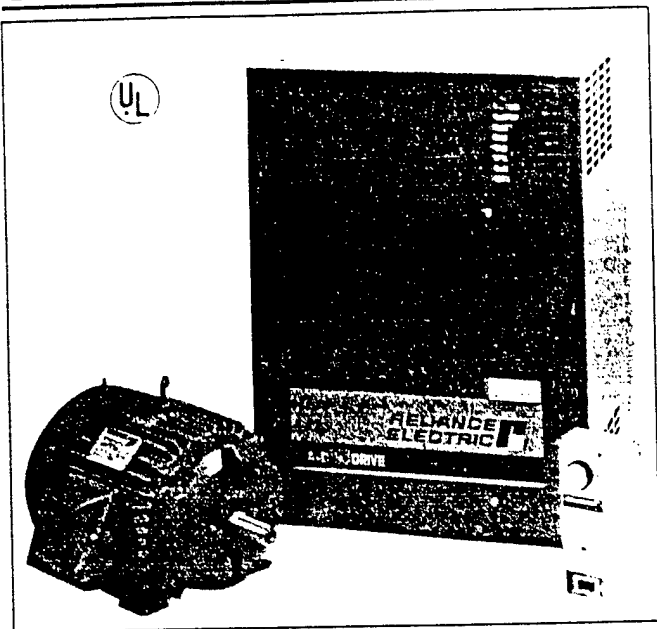
# V★ DRIVES

### STANDARD FEATURES

- Controller speed range of 6 to 120 Hertz with a constant torque capability up to 90 Hertz or constant horsepower above 60 Hertz (2)(3)
- Electronic reversing from any speed.
- Start-stop and speed selection with coast-to-rest as standard or ramp-to-rest by jumper selection on "stop."
- Jog at preset speed or at speed set on speed potentiometer.
- Input fuses.
- Insensitive to incoming power phase sequence.
- Acceleration/deceleration control adjustable over range of 2 to 20 seconds by separate ramps.
- Minimum speed adjustment of 6 to 35 Hertz.
- Adjustable volts/Hertz.
- Adjustable voltage boost for increasing breakaway and accelerating torque.
- Output frequency stabilized to  $\pm 0.5\%$  of set speed for  $+10\%$  to  $-5\%$  change in line voltage or  $15^\circ\text{C}$  change in ambient temperature.
- Three-phase output voltage regulated to  $\pm 1\%$  of rated voltage with  $+10\%$  to  $-5\%$  variations in plant power.
- Standard off-the-shelf, NEMA B and synchronous motors (3600, 1800, 1200 rpm) can be used without derating controller.
- Automatic shutoff under output short circuit conditions or when load current exceeds 150% of maximum output amps (RMS) for constant torque drives or 110% of maximum output amps (RMS) for variable torque drives.
- Input fuses.
- Line transient protection prevents power line transients from harming the controller.
- Relay contact to provide external signal for IET and run condition.
- Monitor lamps for each power stage provide immediate indication of drive functioning.
- Digital master/follower capability where several drives must operate at the same speed.
- Operator control isolation increases operator safety.
- Pre-engineered modification kits can be installed in the standard controller enclosure.
- Adjustable Full-Time Current Limit - 50 to 150% of controller full-load rating on constant torque controllers or 50 to 110% of controller full-load rating on variable torque controllers.
- Tester Card - for use during startup and to simplify troubleshooting.
- 24 volt D-C control circuits (start, jog, forward, reverse).

### OPTIONAL FEATURES

- Dynamic Braking - up to 150% of drive rating on intermittent basis.
- Isolated Process Control Follower - accepts 0 to 5 mA, 1 to 5 mA, 4 to 20 mA, 10 to 50 mA, 0 to 10 VDC or 25 to 250 VDC signal.
- Input Disconnect.
- Output Contactor - for positive motor disconnect.
- Output Overload Relays - using individual phase bimetallic thermal sensors.
- Frequency Meter - 0 to 120 Hz Scale.
- Ammeter - ampere scale depending upon drive rating.
- Voltmeter - 0 to 500V scale. (460V drives) or 0 to 750V scale (575V drives).
- Isolation Transformers.
- 115 VAC Control Power - for operator's control devices.
- Master Isolated Reference Transmitter and Receiver - operates up to 10 drives from one operator control with each drive having speed trim capabilities.
- Master Controller - operates up to 12 drives at the same speed from one operator control.
- Manual or Auto Bypass - To switch the motor to or from the controller to the line.
- LED Status display panel door mounted. Separate LED indication of Power Run, Overcurrent, Overvoltage, Line Fault, Motor Over Current, External Fault.
- Door mounted operator's control station.
- Available CSA.
- Pressure-to-Electrical transducer accepts a 3-15 psi signal for automatic control.
- Auto-restart after controller fault. For controllers in remote or unmanned locations subject to line disturbances.
- Other options available - Contact your Reliance Electric Sales Office for more information.



The Definite Purpose, VVI Three-Phase Input A-C V★S Drive operates directly from 460 or 575 volt, three-phase, 50/60 Hz plant power. By producing adjustable frequency, adjustable voltage three-phase output, the A-C V★S Drive allows the use of an A-C squirrel cage induction motor as an adjustable speed device. The Reliance A-C V★S Drive consists of the following elements:

**CONTROLLER** - The controller is available in a standard NEMA 12 enclosure 5-10 HP, NEMA 12 Ventilated enclosure 15-25 HP, and NEMA 1 enclosure 30-150 HP. The regulator is of modular construction for quick and easy repair when necessary. All adjustments are conveniently located, so the drive can be quickly adjusted to meet application requirements. The controller provides standard 6 to 60 Hz, 460 or 575 volt A-C maximum output for constant torque applications or 6-66 Hz maximum output for variable torque applications.

**OPERATOR'S CONTROL STATION** - Contains the speed adjustment potentiometer and control devices to operate the drive.

**A-C MOTOR** - The three-phase A-C motor can be driven as an adjustable speed device by the A-C V★S Drive. Furthermore, one or more motors can be used with a single controller as long as the total motor full load current does not exceed the maximum motor sine wave current rating of the controller. (1)

**STANDARD INDUCTION MOTORS** offer approximately 3% speed regulation from no load to full load due to motor "slip." These motors are frequently carried in stock. Consult the A-C motor price pages for standard induction motors with protected, totally enclosed, explosion-proof, or special enclosures.

**SYNCHRONOUS MOTORS** of either the permanent magnet rotor (PMR) or synchronous reluctance design provide 0% speed regulation from no load to full load. Motor speed is uniquely and completely controlled by controller output frequency. They are ideally suited for: 1) Applications requiring little or no speed change with a change in load, 2) Multi-motor applications where identical motor-to-motor shaft speeds are required. **Synchronous motors normally are not operated above base speed in the constant horsepower region.** For operation above 60 Hertz contact Reliance Electric Sales Office.

(1) See Selection and Application of A-C V★S Drives manual D-9054, or contact your Reliance Electric Sales Office for assistance.

Contact your Reliance Electric Sales Office for assistance where operation above 70 Hertz for 2 pole motors and 90 Hertz for all other motors is required.

(3) Variable Torque Controllers are preset for 6-66 Hz maximum.

**RELIANCE  
ELECTRIC**

# DEFINITE PURPOSE A-C V\*S DRIVES VVI MODIFICATIONS



## LIST OF MODIFICATIONS

Description	Variable Torque (1VT) HP	Constant Torque (24C) HP	480V Model	575V Model	Page
Separately Mounted Devices					
Voltmeter	5-150	5-125	34C401 ♦	34C402	D1-28
Frequency Meter	5-150	5-125	34C421 ♦	34C422	D1-28
Ammeter	5	5	34C418 ♦	34C418	D1-28
Ammeter	7 1/2-10	7 1/2	34C417 ♦	34C417	D1-28
Ammeter	-	10	34C414 ♦	34C414	D1-28
Ammeter	15-20	15	34C415 ♦	34C415	D1-28
Ammeter	25	20	34C416 ♦	34C416	D1-28
Ammeter	-	25-30	34C419 ♦	34C419	D1-28
Ammeter	30-50	40	34C409 ♦	34C409	D1-28
Ammeter	60-100	50-75	35C401 ♦	35C401	D1-28
Ammeter	125-150	100-125	35C402 ♦	35C402	D1-28
Input Disconnect	5	5	34C437 ♦	34C437	D1-28
Input Disconnect	7 1/2-10	7 1/2	34C438 ♦	34C438	D1-28
Input Disconnect	-	10	34C439 ♦	34C439	D1-28
Input Disconnect	15-20	15	34C440 ♦	34C440	D1-28
Input Disconnect	25	20	34C441 ♦	34C441	D1-28
Input Disconnect	30-50	25-40	34C444 ♦	34C444	D1-28
Input Disconnect	60-100	50-75	35C403 ♦	35C403	D1-28
Input Disconnect	125-150	100-125	35C404 ♦	35C404	D1-28
Pressure-to-Electrical Transducer	5-150	-	34C601 ♦	34C601	D1-28
Process Controller Interface Manual Bypass	5-150	5-125	34C482 ♦	34C482	D1-29
	5-150	5-125	-	-	D4-4
Motor Overload	5-25	5-20	34C452 ♦	34C552	D1-29
Motor Overload	30-50	25-40	34C453 ♦	34C553	D1-29
Motor Overload	60-100	50-75	35C407 ♦	35C507	D1-29
Motor Overload	125-150	100-125	35C408 ♦	35C508	D1-29
115 VAC Control	5-150	5-125	-	-	D1-28
Isolation Transformers	5-150	5-125	-	-	D1-30
Line Reactors	5-150	5-125	-	-	D1-30
Controller Enclosures	5-150	5-125	-	-	D1-30
Other Modifications	5-150	5-125	-	-	D4-3
LED 1st Fault Panel	5-150	5-125	34C610 ♦	34C610	D1-28
Auto Restart After Fault	5-150	5-125	34C611 ♦	34C611	D1-28

INDICATING METERS are provided in NEMA 1 enclosures for separate mounting. The meters listed below provide indications of the A-C V\*S Drive Controller's Speed (0-110%, 0-66 Hz Dual Scale), voltage, current (scale depending upon controller rating), and input kilowatt (scale depending upon controller rating). (Wt. 3 lbs)

Special Meter Scale ..... \$55 List

Meter Indicating	Variable Torque (1VT) HP	Constant Torque Controller (24C) HP	480 Volt Model	575 Volt Model	List Price	
					Factory Installed	Customer Installed
Speed Indicator	5-150	5-125	34C421 ♦	34C422	\$338	\$275
Voltage	5-150	5-125	34C401 ♦	34C402	275	200
Current	5	5	34C418 ♦	34C418 ♦	275	200
	7 1/2-10	7 1/2	34C417 ♦	34C417 ♦	275	200
	-	10	34C414 ♦	34C414 ♦	275	200
	15-20	15	34C415 ♦	34C415 ♦	275	200
	25	20	34C416 ♦	34C416 ♦	275	200
	-	25-30	34C419 ♦	34C419 ♦	275	200
	30-50	40	34C409 ♦	34C409 ♦	275	200
	60-100	50-75	35C401 ♦	35C401 ♦	275	200
	125-150	100-125	35C402 ♦	35C402 ♦	275	200

INPUT DISCONNECT KIT provides a positive disconnect of all power input leads for the controllers. This kit is designed to mount internal to the controller enclosure and includes a thru-the-door interlocking handle. Will accept a padlock lockout. (Wt. 3 lbs)

The basic switch is a magnetic, molded case circuit breaker.

Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	INTERRUPTING CAPACITY		Model	INPUT DISCONNECT KIT	
		Sym. Amps			List Price	
		480 VAC	575 VAC		Factory Installed	Customer Installed
5	5	65,000	25,000	34C437 ♦	\$382	\$312
7 1/2-10	7 1/2	65,000	25,000	34C438 ♦	382	312
-	10	65,000	25,000	34C439 ♦	413	344
15-20	15	65,000	25,000	34C440 ♦	415	345
25	20	65,000	25,000	34C441 ♦	475	406
30-50	25-40	65,000	25,000	34C444 ♦	800	531
60-100	50-75	65,000	25,000	35C403 ♦	915	845
125-150	100-125	65,000	25,000	35C404 ♦	1,163	1,095

PRESSURE-TO-ELECTRICAL TRANSDUCER converts a 3-15 psi pneumatic process signal into an electrical signal which the drive is designed to follow. This kit mounts conveniently inside the controller. An unmounted Auto-Manual switch is provided.

NOTE: When ordered Factory Installed with a separately enclosed Line Bypass. This kit mounts inside the Line Bypass Enclosure. Please specify this kit as Factory Installed in the Line Bypass Cabinet when ordering with separately enclosed Line Bypass on pages D4-4 thru D4-5.

Variable Torque Controller (1VT) HP	Model	Weight	List Price	
			Factory Installed	Customer Installed
5-150	34C801 ♦	1	\$440	\$375

DOOR MOUNTED OPERATOR'S CONTROL STATION includes start/stop/reset switch and manual speed potentiometer.

Model 10C4005 ..... \$175 List  
Factory Installed ..... \$200 List

## MODIFICATIONS

LED 1ST FAULT DISPLAY PANEL provides a door mounted visual display of controller status with 7 LED's indicating: VFD Power On, VFD Run, VFD Overcurrent, VFD Overvoltage, Input Line Fault, Motor Overcurrent, External Fault.

Model 34C610 ♦ (for 'U' suffix drives only) ..... \$625 List  
Factory Installed ..... \$650 List

AUTO-RESTART AFTER CONTROLLER FAULT OR POWER OUTAGE. Reliance A-C V\*S controllers will attempt a restart after power failure as a standard feature provided the controller is in the "Auto" mode and continues to receive a Run command via a contact closure on the "Auto" start terminals. (NOTE: If the controller has protected itself from a low line condition prior to the power failure, the controller will not attempt a restart.) This modification attempts up to three restart attempts after either a controller fault or power outage.

Model 34C611 ♦ (for 'U' suffix IVT only) ..... \$470 List  
Factory Installed ..... \$500 List

115 VAC CONTROL KIT is used when start, stop and other control functions are to be input at 115 volt A-C rather than the controller's standard 24 volt D-C. This would normally be used only when the drive is to interact with other 115 volts systems. See Page D4-3 for pricing.

# V★S DRIVES

## DEFINITE PURPOSE A-C V★S DRIVES VVI MODIFICATIONS

**MOTOR OVERLOAD KIT** contains a thermal overload relay designed to protect one A-C motor from extended overload operation. It is important to note that this kit effectively provides overload protection for single motor applications only. Multiple motor applications may require individual overload relays for each of the motors in the system to comply with electrical codes.

This motor overload relay is suitable for operation down to one-half base speed of the motor. It may not protect the motor when operating below one-half base speed because, at these speeds, motor damage can be caused by factors other than overloads. For maximum motor protection under these conditions, the use of thermal protection embedded in the motor windings is recommended. This kit is designed to mount internal to the controller enclosure.

Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	MOTOR OVERLOAD KIT			
		Model (1)		List Price	
		460 VAC	575 VAC	Factory Installed	Customer Installed
5-25	5-20	34C452◆	34C552	\$319	\$250
30-50	25-40	34C453◆	34C553	388	319
60-100	50-75	35C407◆	35C507	388	319
125-150	100-125	35C408◆	35C508	461	393

**OUTPUT CONTACTOR KIT** provides a positive disconnect of all controller output leads to the motor. This kit is designed to mount internal to the controller enclosure. (Wt. 10 lbs)

Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	OUTPUT CONTACTOR KIT (1)		
		Model	List Price	
			Factory Installed	Customer Installed
5-10	5-7½	34C456◆	\$ 563	\$ 494
15-20	10-15	34C458◆	563	494
25	20	34C459◆	619	550
30-50	25-40	34C460◆	1,106	981
60-100	50-75	35C409◆	1,575	1,450
125-150	100-125	35C410◆	2,786	2,661

**OPTIONAL AUXILIARY CONTACTS:** Maximum two (2) per contactor kit. These contacts are used for auxiliary control functions and are installed on the output contactor. An output contactor must be ordered if these are required. As an alternate, if an output contactor is not required, control relays can be used. Refer to the modification section.

Ordering Number	Contacts	List Price
608830-2R	1NO, 1NC	\$50
608830-2S	2NC	50
608830-2T	2NC	50
608830-2V	1NC	50

### SWITCH RATING

Load	Voltage	Current (A) Normal
Inductive A-C	110-125	3.00
	220-250	1.50
	440-480	0.75
D-C	115-125	1.10
	230-250	0.55

(1) Not available as a Factory Installed option on Chassis units.

### DISCOUNT RE-3AC and RE-5AC

◆ Normally carried in stock.

**DYNAMIC BRAKING KIT WITH CURRENT LIMIT** (This kit is recommended for high inertia loads) provides rapid deceleration of the drive motor and/or enables the controller to provide 150% intermittent braking to the motor. The kit dissipates through resistors, in the form of heat, the power regenerated by the motor during deceleration or intermittent overhauling loads.

The kit contains an adjustable regeneration current limit circuit which decreases the drive's Decel Rate and Accel Rate as required to stay within a given current limit. The range of this deceleration current limit is approximately 80 to 150% of the drive's full-load current. This kit also includes motoring current limit, which is the same as in the Current Limit Kit, Model 34C511.

The Dynamic Braking Kit, including the resistor assembly, is designed to mount inside the controller enclosure. The resistor will be mounted in a NEMA 1 external enclosure. (Wt. 15 lbs)

Constant Torque Controller (24C) HP	DYNAMIC BRAKING KIT (1)			
	Model		List Price	
	460 VAC	575 VAC	Factory Installed	Customer Installed
5-10	34C474◆	34C574	\$913	\$844
15-20	34C475◆	34C575	913	844
25-40	34C479◆	34C579	1,875	1,750
50-75	35C405◆	35C505	2,500	2,375
100-125	35C406◆	35C506	4,063	3,938

**ISOLATED PROCESS CONTROLLER INTERFACE KIT** enables the A-C V★S Drive to follow a 0-5, 1-5, 4-20, 10-50 mA; or 0-4, 0-8, 0-10 VDC grounded or ungrounded signal from a process controller and to operate over a greater speed range than the 5:1 range provided by the process controller.

An optional Voltage/Tachometer Follower Kit, Model 14C223, may be added to the Process Controller Interface Kit. The voltage source is generally a tachometer generator connected to an entirely separate machine. The kit will accept an input signal of 25 to 250 VDC to obtain maximum speed. The kit has a trim pot mounted on the printed circuit board. The maximum permissible input voltage is 250 VDC. The input impedance is approximately 80,000 ohms.

The Tachometer Interface Adapter, Model 14C221, provides a means to automatically control the speed of the A-C V★S Drive from a tachometer signal. The voltage source is generally a tachometer generator connected to an entirely separate machine. Either an A-C or D-C tachometer can be used. Maximum input signal is 250 volts.

Auto-Manual switch provided.

This kit is designed to mount inside the controller enclosure.

Model 34C482◆ ..... \$258 List  
Factory Installed (1) ..... \$329 List

Optional Voltage Follower Kit  
Model 14C223◆ (Wt. 2 lbs) ..... \$75 List  
Tachometer Interface Adapter  
Model 14C221◆ (Wt. 2 lbs) ..... \$88 List

**RELIANCE  
ELECTRIC**

EFFECTIVE January 2, 1991 D1-29

## DEFINITE PURPOSE A-C V★S DRIVES VVI MODIFICATIONS



**MASTER ISOLATED REFERENCE** controls up to 10 separate drives with the reference circuit of each drive isolated from all other drives and from the reference input. The reference input can be from an A-C or D-C tachometer, conventional self-contained speed potentiometer, instrument interface, or other voltage source. A self-contained linear voltage timing circuit offers separate rates of controlled acceleration and deceleration: 1 to 30 seconds. Each drive speed reference can be "trimmed" in relation to each other.

**TRANSMITTER:** See description and pricing on page D4-12 option section page. Mounts separate from the controller.

Model 11C90♦ (Wt. 10 lbs)

**RECEIVER:** This kit converts the pulse width modulated signal from the transmitter to a 0-10 volt D-C reference signal. The kit also includes a relay, for group starting and stopping, and an automatic/manual selector switch. Kit mounts conveniently inside the controller.

Model 34C492♦ (Wt. 2 lbs) ..... \$193 List  
Factory Installed ..... \$263 List  
(Not available as a factory installed option on chassis units.)

**MASTER CONTROLLER** enables the operator to simultaneously control the speed of several drives from one location. See description and pricing on page D4-12.

Models 9C53♦ 9C54♦ (Wt. 8.5 and 9.6 lbs, respectively)

**CONTROLLER ENCLOSURES**, available as alternates to the standard enclosures, are listed below. Specify the controller model and make the appropriate deduction from or addition to the standard price.

HP	Enclosure	460 Volt Controller Model	575 Volt Controller Model	List Price
5	Chassis	24C4005	24C5005	Deduct \$269
7 1/2	Chassis	24C4007	24C5007	Deduct \$269
10	Chassis	24C4010	24C5010	Deduct \$269
15	Chassis	24C4015	24C5015	Deduct \$313
20	Chassis	24C4020	24C5020	Deduct \$313
25-30	Chassis	24C4030	24C5030	Deduct \$344
40	Chassis	24C4040	24C5040	Deduct \$344
25-30	NEMA 12 Ventilated	24C4230	24C5230	Add \$656
40	NEMA 12 Ventilated	24C4240	24C5240	Add \$663
50-75	NEMA 1 Positive Pressure	24C4275	24C5275	Add \$1,063
100-125	NEMA 1 Positive Pressure	24C42125	24C52125	Add \$1,063

HP	Enclosure	460 Volt Controller Model	575 Volt Controller Model	List Price
5	Chassis	1VT4005U	1VT5005C	Deduct \$263
7 1/2	Chassis	1VT4007U	1VT5007C	Deduct \$263
10	Chassis	1VT4010U	1VT5010C	Deduct \$263
15	Chassis	1VT4015U	1VT5015C	Deduct \$263
20	Chassis	1VT4020U	1VT5020C	Deduct \$300
25	Chassis	1VT4025U	1VT5025C	Deduct \$300
30	Chassis	1VT4030U	1VT5030C	Deduct \$331
40	Chassis	1VT4040U	1VT5040C	Deduct \$331
50	Chassis	1VT4050U	1VT5050C	Deduct \$331
30	NEMA 12 Ventilated	1VT4230U	1VT5230C	Add \$638
40	NEMA 12 Ventilated	1VT4240U	1VT5240C	Add \$638
50	NEMA 12 Ventilated	1VT4250U	1VT5250C	Add \$638
60	NEMA 1 Positive Pressure	1VT4260U	1VT5260C	Add \$1,031
75	NEMA 1 Positive Pressure	1VT4275U	1VT5275C	Add \$1,031
100	NEMA 1 Positive Pressure	1VT42100U	1VT52100C	Add \$1,031
125	NEMA 1 Positive Pressure	1VT42125U	1VT52125C	Add \$1,031
150	NEMA 1 Positive Pressure	1VT42150U	1VT52150C	Add \$1,031

**ISOLATION TRANSFORMERS** are provided only for use on the input A-C line to the controller. The transformer enclosure is NEMA 1. Although Reliance solid-state drives are designed to operate from normal industrial power distribution systems with the recommended maximum A-C line distribution system capacity without the need of an isolation transformer, the following benefits of isolation transformers should be considered.

1. Local codes may require a transformer.
2. Where environmental conditions subject the drive (particularly the motor) to distinct possibility of accidental or partial grounding.
3. Transformer isolates the V★S Drive circuitry from plant A-C line voltage adding increased reliability.
4. The transformer will help reduce A-C line voltage transients from reaching the drive circuitry.

### ISOLATION TRANSFORMERS FOR THREE-PHASE A-C V★S VVI DRIVES (1) (OPERATION FROM 60 HZ POWER ONLY)

See page D4-17 for specifications, prices, dimensions and weights.

Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	Transformer KVA
5	-	7 1/2
7 1/2	5	11
10	7 1/2	15
15	10	20
20	15	27
25	-	34
30	20	34
-	25	51
40	30	51
50	40	63
60	-	75
75	50	93
100	60	118
-	75	118
125	-	145
150	100	175
-	125	175

**LINE REACTORS** can be used to provide additional impedance if the A-C line short circuit capacity exceeds the maximum allowable short circuit capacity of the drive as listed under service conditions on page D1-36 or D1-37. Line reactors are an alternative to using isolation transformers to add impedance providing that line voltage corresponds to the controller rating. The line reactors are supplied in NEMA 1 enclosures designed for separate mounting. See page D4-19 for application information, sizing, pricing and dimensions.

(1) An input isolation transformer is required for operation on corner grounded delta plant power systems.

### ENGINEERING DATA

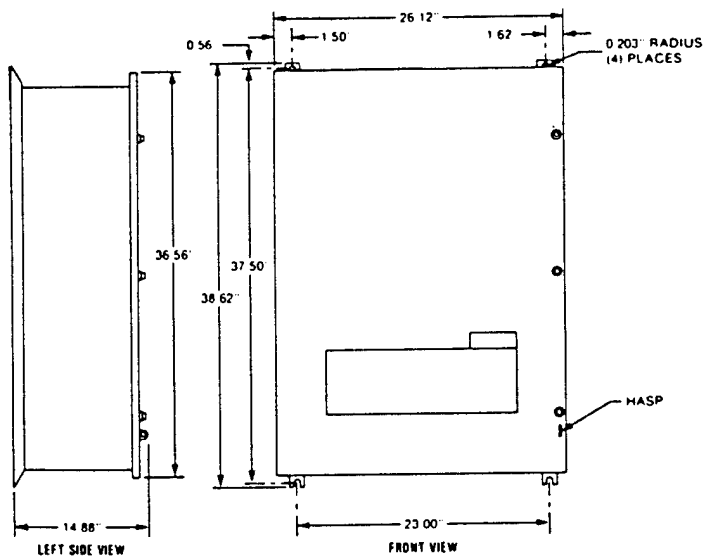
#### MOUNTING DIMENSIONS AND WEIGHTS (NOT FOR CONSTRUCTION)

##### PHYSICAL DIMENSIONS OF 5-10 HORSEPOWER CONTROLLERS

##### WEIGHT (lbs)

Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	Chassis	NEMA 12 Cabinet
5	5	190	205
7½	7½	190	205
10	10	190	205

##### CABINET

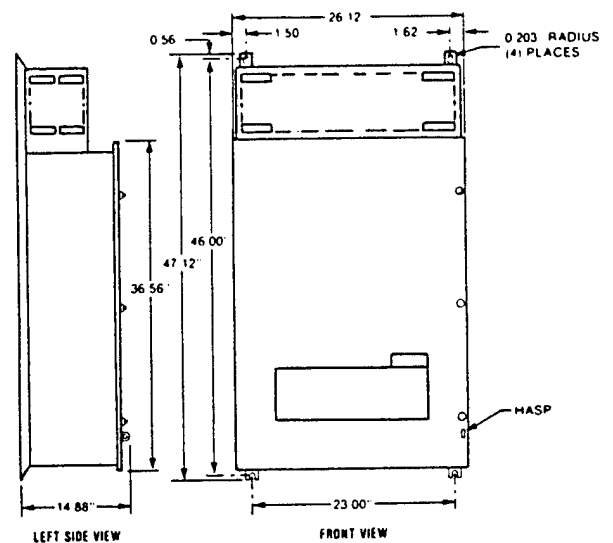


##### PHYSICAL DIMENSIONS OF 15-25 HORSEPOWER CONTROLLERS

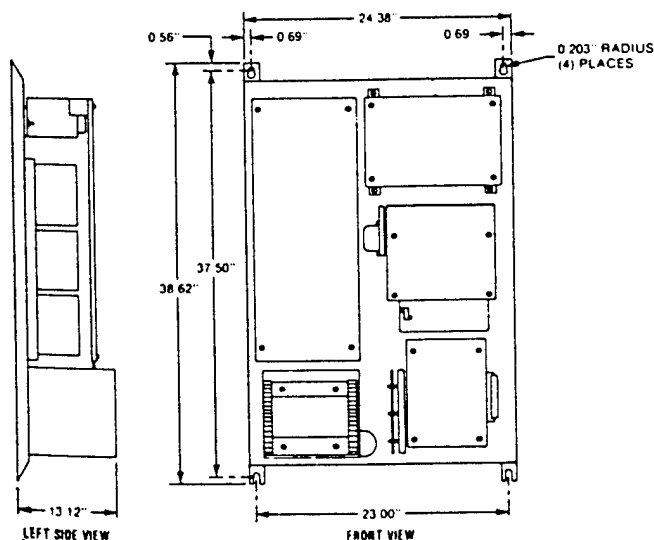
##### WEIGHT (lbs)

Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	Chassis	NEMA 12 Cabinet
15	15	220	235
20	20	220	235
25	-	220	235

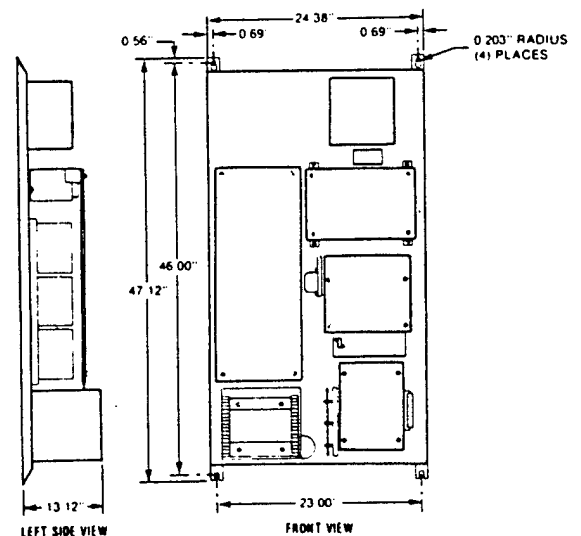
##### CABINET



##### CHASSIS



##### CHASSIS





**DEFINITE PURPOSE  
A-C V $\star$ S DRIVES  
VVI 5-150 HP**



**ENGINEERING DATA**

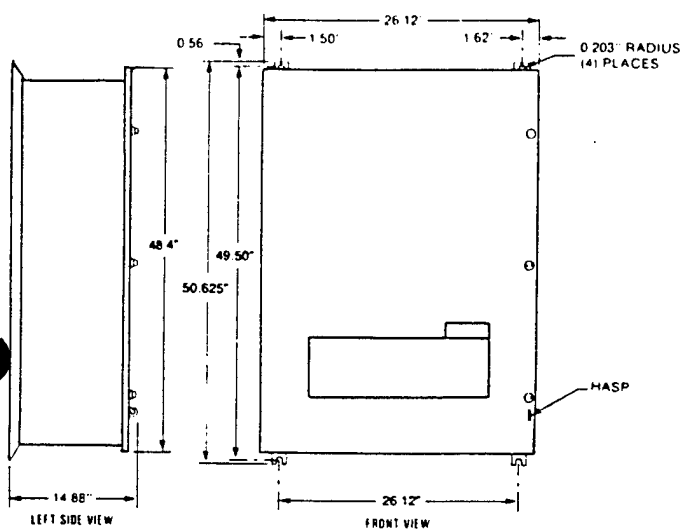
**MOUNTING DIMENSIONS AND WEIGHTS (NOT FOR CONSTRUCTION)**

**PHYSICAL DIMENSIONS OF  
25-30 HP CONTROLLERS**

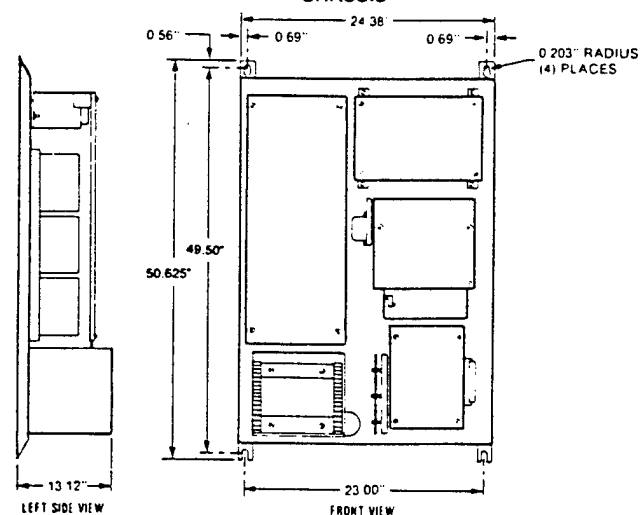
**WEIGHT (lbs)**

Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	Chassis	NEMA 1 Cabinet	NEMA 12 Cabinet
30	25-30	310	352	552

**CABINET**



**CHASSIS**

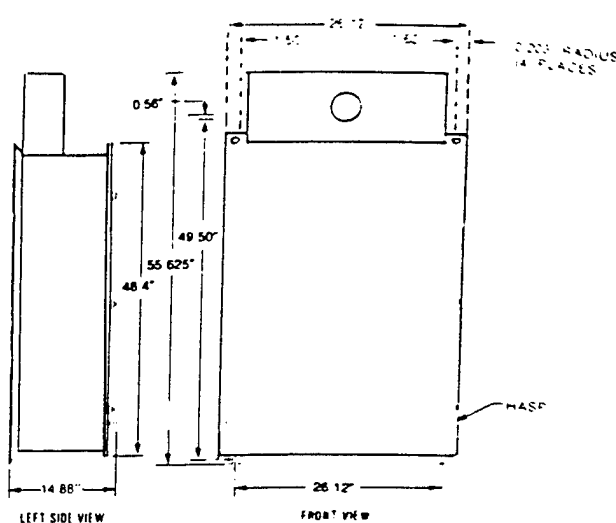


**PHYSICAL DIMENSIONS OF  
40-50 HP CONTROLLERS**

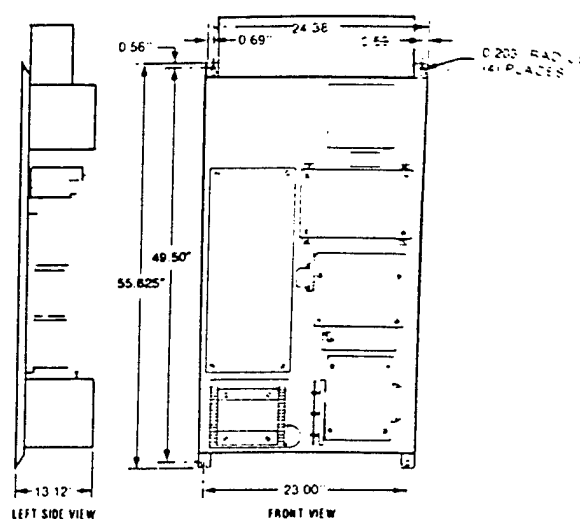
**WEIGHT (lbs)**

Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	Chassis	NEMA 1 Cabinet	NEMA 12 Cabinet
40-50	40	330	370	570

**CABINET**



**CHASSIS**



Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	NEMA 12 Cabinet
30-50	25-40	32"W x 20"D x 86"H

### ENGINEERING DATA

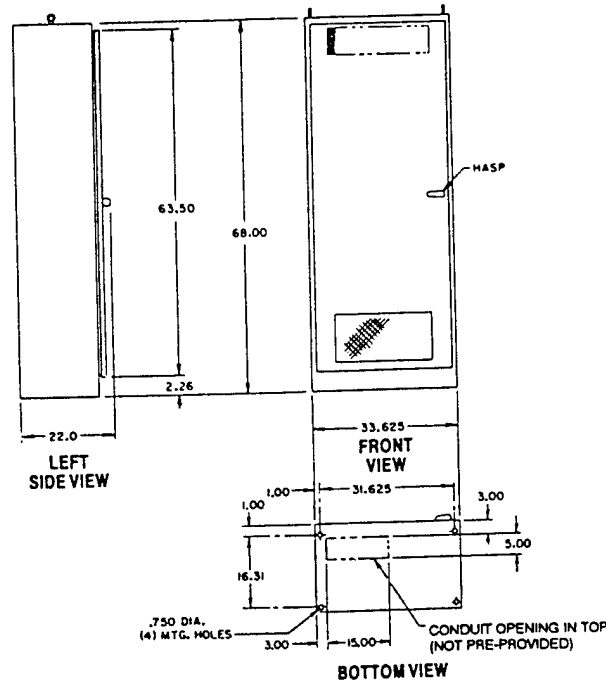
#### MOUNTING DIMENSIONS AND WEIGHTS (NOT FOR CONSTRUCTION)

#### PHYSICAL DIMENSIONS OF 50-150 HORSEPOWER CONTROLLERS

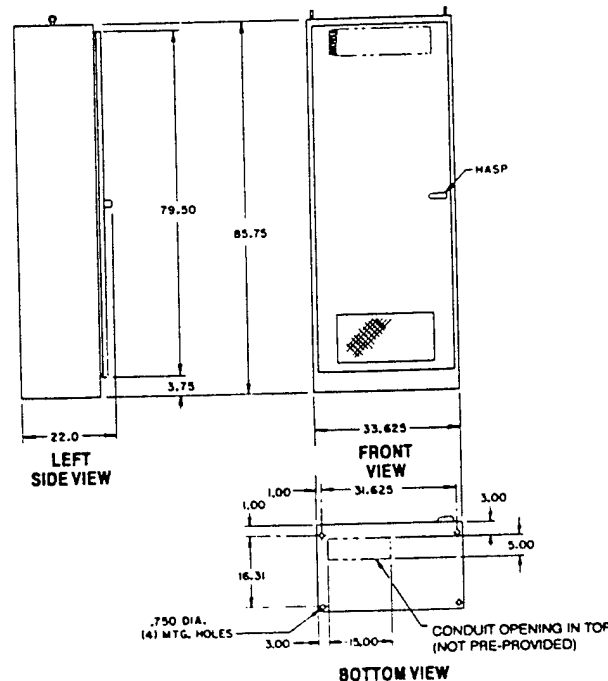
WEIGHT (lbs)

Variable Torque Controller (1VT) HP	Constant Torque Controller (24C) HP	NEMA 1
60-100	50-75	800
125-150	100-125	1000

NEMA 1 ENCLOSURE  
FOR 60 THRU 100 HP Variable Torque (1VT) Controllers  
FOR 50 THRU 75 HP Constant Torque (24C) Controllers



NEMA 1 ENCLOSURE  
FOR 125 THRU 150 HP Variable Torque (1VT) Controllers  
FOR 100 THRU 125HP Constant Torque (24C) Controllers



DIMENSIONS IN INCHES

# DEFINITE PURPOSE A-C V\*S DRIVES VVI 5-150 HP



## REPLACEMENT MODULES

### 5-125 HP (CONSTANT TORQUE) THREE-PHASE, 460 VOLT INPUT/OUTPUT

HP	Model Number	Fuse Kit Kit Number	Power Module Kit Kit Number	Regulator Card Kit Kit Number
5	24C4205U	K-672-AF	K-673-AH	K-670-Q
7 1/2	24C4207U	K-672-AF	K-673-AK	K-670-Q
10	24C4210U	K-672-AF	K-673-AK	K-670-Q
15	24C4215U	K-672-AF	K-673-AJ	K-670-Q
20	24C4220U	K-672-AG	K-673-AJ	K-670-Q
25	24C4130U	K-672-AH	K-673-F	K-670-Q
30	24C4130U	K-672-AH	K-673-F	K-670-Q
40	24C4140U	K-672-AJ	K-673-F	K-670-Q
50	24C4175U	K-672-AK	K-673-P	K-670-R
60	24C4175U	K-672-AK	K-673-P	K-670-R
75	24C4175U	K-672-AK	K-673-P	K-670-R
100	24C41125U	K-672-AL	K-673-P	K-670-R
125	24C41125U	K-672-AL	K-673-P	K-670-R

### 5-125 HP (CONSTANT TORQUE) THREE-PHASE, 575 VOLT INPUT/OUTPUT

HP	Model Number	Fuse Kit Kit Number	Power Module Kit Kit Number	Regulator Card Kit Kit Number
5	24C5205U	K-672-AF	K-673-G	K-670-Q
7 1/2	24C5207U	K-672-AF	K-673-G	K-670-Q
10	24C5210U	K-672-AF	K-673-G	K-670-Q
15	24C5215U	K-672-AG	K-673-H	K-670-Q
20	24C5220U	K-672-AG	K-673-H	K-670-Q
25	24C5130U	K-672-AH	K-673-AG	K-670-Q
30	24C5130U	K-672-AH	K-673-AG	K-670-Q
40	24C5140U	K-672-AJ	K-673-AG	K-670-Q
50	24C5175U	K-672-AK	K-673-P	K-670-R
60	24C5175U	K-672-AK	K-673-P	K-670-R
75	24C5175U	K-672-AK	K-673-P	K-670-R
100	24C51125U	K-672-AL	K-673-M	K-670-R
125	24C51125U	K-672-AL	K-673-M	K-670-R

### 5-150 HP (VARIABLE TORQUE) 460 VOLT THREE-PHASE INPUT/OUTPUT

HP	Model Number	Kit Number	Kit Number	Kit Number
5	1VT4005U 1VT4205U	K-672-AF K-672-AF	K-673-AH K-673-AH	K-670-Q K-670-Q
7 1/2	1VT4007U 1VT4207U	K-672-AF K-672-AF	K-673-AH K-673-AH	K-670-Q K-670-Q
10	1VT4010U 1VT4210U	K-672-AF K-672-AF	K-673-AH K-673-AH	K-670-Q K-670-Q
15	1VT4015U 1VT4215U	K-672-AG K-672-AG	K-673-AJ K-673-AJ	K-670-Q K-670-Q
20	1VT4020U 1VT4220U	K-672-AG K-672-AG	K-673-AJ K-673-AJ	K-670-Q K-670-Q
25	1VT4025U 1VT4225U	K-672-AG K-672-AG	K-673-AJ K-673-AJ	K-670-Q K-670-Q
30	1VT4030U 1VT4130U 1VT4230U	K-672-AH K-672-AH K-672-AH	K-673-F K-673-F K-673-F	K-670-Q K-670-Q K-670-Q
40	1VT4040U 1VT4140U 1VT4240U	K-672-AJ K-672-AJ K-672-AJ	K-673-F K-673-F K-673-F	K-670-Q K-670-Q K-670-Q
50	1VT4050U 1VT4150U 1VT4250U	K-672-AJ K-672-AJ K-672-AJ	K-673-F K-673-F K-673-F	K-670-Q K-670-Q K-670-Q
60	1VT4160U 1VT4260U	K-672-AK K-672-AK	K-673-P K-673-P	K-670-R K-670-R
75	1VT4175U 1VT4275U	K-672-AK K-672-AK	K-673-P K-673-P	K-670-R K-670-R
100	1VT41100U 1VT42100U	K-672-AK K-672-AK	K-673-P K-673-P	K-670-R K-670-R
125	1VT41125U 1VT42125U	K-672-AN K-672-AN	K-673-P K-673-P	K-670-R K-670-R
150	1VT41150U 1VT42150U	K-672-AN K-672-AN	K-673-P K-673-P	K-670-R K-670-R

### 5-150 HP (VARIABLE TORQUE) 575 VOLT THREE-PHASE INPUT/OUTPUT

HP	Model Number	Kit Number	Kit Number	Kit Number
5	1VT5005U 1VT5205U	K-672-AF K-672-AF	K-673-G K-673-G	K-670-Q K-670-Q
7 1/2	1VT5007U 1VT5207U	K-672-AF K-672-AF	K-673-G K-673-G	K-670-Q K-670-Q
10	1VT5010U 1VT5210U	K-672-AF K-672-AF	K-673-G K-673-G	K-670-Q K-670-Q
15	1VT5015U 1VT5215U	K-672-AG K-672-AG	K-673-H K-673-H	K-670-Q K-670-Q
20	1VT5020U 1VT5220U	K-672-AG K-672-AG	K-673-H K-673-H	K-670-Q K-670-Q
25	1VT5025U 1VT5225U	K-672-AG K-672-AG	K-673-H K-673-H	K-670-Q K-670-Q
30	1VT5030U 1VT5130U 1VT5230U	K-672-AH K-672-AH K-672-AH	K-673-AG K-673-AG K-673-AG	K-670-Q K-670-Q K-670-Q
40	1VT5040U 1VT5140U 1VT5240U	K-672-AJ K-672-AJ K-672-AJ	K-673-AG K-673-AG K-673-AG	K-670-Q K-670-Q K-670-Q
50	1VT5050U 1VT5150U 1VT5250U	K-672-AJ K-672-AJ K-672-AJ	K-673-AG K-673-AG K-673-AG	K-670-Q K-670-Q K-670-Q
60	1VT5160U 1VT5260U	K-672-AK K-672-AK	K-673-P K-673-P	K-670-R K-670-R
75	1VT5175U 1VT5275U	K-672-AK K-672-AK	K-673-P K-673-P	K-670-R K-670-R
100	1VT51100U 1VT52100U	K-672-AK K-672-AK	K-673-P K-673-P	K-670-R K-670-R
125	1VT51125U 1VT52125U	K-672-AL K-672-AL	K-673-M K-673-M	K-670-R K-670-R
150	1VT51150U 1VT52150U	K-672-AL K-672-AL	K-673-M K-673-M	K-670-R K-670-R

## RECOMMENDED SPARE PARTS KITS

Kit tables listed cover standard Drives designated by model number. The power module kits can be used with modified standard Drives.

Each kit contains the most essential parts for good spare parts protection and is ideal for start-up spares.

All orders not entered with the drive order should be entered with a Reliance Parts Distributor.

Contact your local Reliance Parts Distributor.

## INSTRUCTION MANUALS

Description	Variable Torque HP	Constant Torque HP	460 V Model	575 V Model	I/M
Drive Instruction Manual containing Wiring Diagrams and Dimensions	5-150	5-125	All	All	D2-3124
Separately Mounted Devices					
Voltmeter	5-150	5-125	34C401	34C402	D-3926
Frequency Meter	5-150	5-125	34C421	34C422	D-3927
Ammeter	5	5	34C418	34C418	D-3902
Ammeter	7 1/2	7 1/2	34C417	34C417	D-3902
Ammeter	10	10	34C414	34C414	D-3902
Ammeter	15	15	34C415	34C415	D-3902
Ammeter	20	20	34C416	34C416	D-3902
Ammeter	25-30	25-30	34C419	34C419	D-3902
Ammeter	40	40	34C409	34C409	D-3902
Ammeter	50-75	50-75	35C401	35C401	D-3902
Ammeter	100-150	100-125	35C402	35C402	D-3902
Input Kilowatt Meter	5	5	1KW4008	1KW4008	D2-3033
Input Kilowatt Meter	7 1/2-10	7 1/2	1KW4015	1KW4015	D2-3033
Input Kilowatt Meter	15-25	10-20	1KW4030	1KW4030	D2-3033
Input Kilowatt Meter	30-40	25-30	1KW4050	1KW4050	D2-3033
Input Kilowatt Meter	50-100	40-75	1KW4120	1KW4120	D2-3033
Input Kilowatt Meter	125-150	100-125	1KW4200	1KW4200	D2-3033
Input Disconnect	5	5	34C437	34C437	D-3929
Input Disconnect	7 1/2-10	7 1/2	34C438	34C438	D-3929
Input Disconnect	-	10	34C439	34C439	D-3929
Input Disconnect	15-20	15	34C440	34C440	D-3929
Input Disconnect	25	20	34C441	34C441	D-3929
Input Disconnect	30-50	25-40	34C444	34C444	D-3929
Input Disconnect	60-100	50-75	35C403	35C403	D-3929
Input Disconnect	125-150	100-125	35C404	35C404	D-3929
Dynamic Braking	-	5-10	34C474	34C574	D-3930
Dynamic Braking	-	15-20	34C475	34C575	D-3930
Dynamic Braking	-	25-40	34C479	34C579	D-3976
Dynamic Braking	-	50-75	35C405	35C505	D-3976
Dynamic Braking	-	100-125	35C406	35C506	D-3976
Process Controller Interface	5-150	5-125	34C482	34C482	D-3931
Magnetic Contactor Bypass	5-150	5-125	-	-	D2-3149
Master Controller	5-150	5-125	9C53	9C53	D-3727
Master Isolated Reference Receiver	5-150	5-125	34C492	34C492	D-3879
Motor Overload	5-25	5-20	34C452	34C552	D-3932
Motor Overload	30-50	25-40	34C453	34C553	D-3932
Motor Overload	60-100	50-75	35C407	35C507	D-3932
Motor Overload	125-150	100-125	35C408	35C508	D-3932
Output Contactor	5-10	5-7 1/2	34C456	34C456	D-3933
Output Contactor	15-20	10-15	34C458	34C458	D-3933
Output Contactor	25	20	34C459	34C459	D-3933
Output Contactor	30-50	25-40	34C460	34C460	D-3933
Output Contactor	60-100	50-75	35C409	35C409	D-3933
Output Contactor	125-150	100-125	35C410	35C410	D-3933
LED 1st Fault Panel	5-150	5-125	34C610	34C610	D2-3126
Pressure to Electrical Transducer	5-150	-	34C601	34C601	D2-3026
Auto Restart After Fault	5-150	-	34C610	34C610	D2-3126

**DEFINITE PURPOSE  
A-C V $\star$ S DRIVES  
VVI 5-150 HP**



**ENGINEERING DATA  
VARIABLE TORQUE (1VT) CONTROLLER RATINGS**

Drive Rating HP (4)	A-C SUPPLY				A-C OUTPUT					
	Three-Phase 50/60 Hz, 460 V		Three-Phase 50/60 Hz, 575 V		Three-Phase 460 V			Three-Phase 575 V		
	Input KVA	Maximum Input Amps	Input KVA	Maximum Input Amps	Output KVA	Max. Motor Sine Wave Amps (3)	Max. Controller Amps	Output KVA	Max. Motor Sine Wave Amps (3)	Max. Controller Amps
5	6.0	8.0	6.0	6.0	6.0	7.3	8.0	6.0	5.5	6.0
7 $\frac{1}{2}$	9.0	11.0	9.0	9.0	9.0	10.0	11.0	9.0	8.2	9.0
10	11.0	14.0	11.0	11.0	11.0	12.7	14.0	11.0	10.0	11.0
15	16.0	20.0	16.0	16.0	16.0	18.2	20.0	16.0	14.6	16.0
20	21.0	27.0	21.0	21.0	21.0	24.5	27.0	21.0	19.1	21.0
25	26.0	33.0	26.0	26.0	26.0	30.0	33.0	26.0	23.7	26.0
30	31.0	39.0	31.0	31.0	31.0	35.5	39.0	31.0	28.2	31.0
40	42.0	52.0	42.0	42.0	42.0	47.3	52.0	42.0	38.2	42.0
50	51.0	64.0	51.0	51.0	51.0	58.2	64.0	51.0	47.3	52.0
60	62.0	77.0	62.0	62.0	62.0	70.0	77.0	62.0	56.4	62.0
75	76.0	95.0	76.0	76.0	76.0	86.4	95.0	76.0	69.2	76.0
100	101.0	126.0	101.0	101.0	101.0	115.0	126.0	101.0	92.0	101.0
125	126.0	157.0	125.0	126.0	125.0	143.0	157.0	125.0	115.0	126.0
150	148.0	185.0	148.0	148.0	148.0	169.0	185.0	148.0	135.0	148.0

**SERVICE CONDITIONS**

Altitude ..... to 3300 ft.  
Ambient Temperature Range  
Cabinet ..... 0°C to 40°C (32°F to 104°F)  
Chassis ..... 0°C to 55°C (131°F)  
Atmosphere ..... Non-Condensing Relative Humidity 5 to 95%  
A-C Line Voltage Variation ..... -5% to +10%  
A-C Line Frequency Variation ..... 50/60 Hz  $\pm$ 2 Hz  
Maximum A-C Line Distribution System  
KVA Capacity ..... 5-25 HP, 142 KVA (1)  
..... 30-50 HP, 263 KVA (1)  
..... 60-100 HP, 482 KVA (1)  
..... 125-150 HP, 784 KVA (1)  
Storage Temperature ..... -40°C to 65°C (-40°F to 149°F)

**ADJUSTMENTS**

Controller adjustments are preset for Reliance Duty Master XE Motors (3600, 1800, 1200 rpm). Adjustments available if required:  
Standard (Nominal Values)  
Acceleration (2) ..... Linear 2 to 20 seconds  
Deceleration (2) ..... Linear 2 to 20 seconds  
Volts/Hertz ..... 5.12 to 15.34 V/Hz  
Voltage Offset (Fundamental RMS) ..... 0 to 40 volts  
Minimum Frequency ..... 6 to 35 Hz  
Maximum Frequency ..... 45 to 66 Hz

**PRODUCT PUBLICATIONS**

Three-Phase Input A-C V $\star$ S Drive Data Sheet  
460 Volt ..... D-2810  
575 Volt ..... D-2810  
Wiring Diagrams  
5-25 HP ..... W/D 29594-4  
30-50 HP ..... W/D 29595-4  
60-150 HP ..... W/D 29596-4

- (1) Distribution system capacity above the maximum recommended KVA requires using an isolation transformer or other means of similar impedance.  
(2) Change resistor for 2-98 seconds.  
(3) The max sine wave amps shown in this column must be used to properly size a controller for motors other than new Reliance Electric motors.  
(4) Controller sizes based on Reliance Electric energy efficient motor ratings.

**APPLICATION DATA**

Standard  
Service Factor ..... 1.0  
Maximum Load ..... 100% continuous  
Regulation  
Voltage .....  $\pm$ 1%  
Frequency Stability Long Term .....  $\pm$ 0.5%  
Continuous Speed Range ..... 6 to 66 Hz  
Maximum Output Voltage  
460 VAC Controller ..... 460 VAC  
575 VAC Controller ..... 575 VAC

**ENGINEERING DATA**  
**CONSTANT TORQUE (24C) CONTROLLER RATINGS**

Drive Rating HP (1)	Three-Phase 50/60 Hz, 460 V		Three-Phase 50/60 Hz, 575 V		460 VAC, Three-Phase			575 VAC, Three-Phase		
	Controller Input KVA	Input Amps (RMS)	Controller Input KVA	Input Amps (RMS)	Controller Output KVA	Current Sine Wave 460 V 6-66 Hz (2)	Current Controller 460 V 6-66 Hz (3)	Controller Output KVA	Current Sine Wave 575 V 6-66 Hz (2)	Current Controller 575 V 6-66 Hz (3)
5	8.0	10.0	8.0	8.0	6.4	8.0	8.8	6.4	6.4	7.0
7 1/2	13.1	16.5	13.1	13.2	10.3	13.0	14.3	10.3	10.4	11.4
10	16.2	20.3	16.2	16.3	12.7	16.0	17.6	12.7	12.8	14.1
15	23.3	29.2	23.3	23.4	18.3	23.0	25.3	18.3	18.4	20.2
20	28.4	35.6	28.4	28.5	22.3	28.0	30.8	22.3	22.4	24.6
30	41.4	52.0	41.4	41.6	33.5	42.0	46.4	33.5	33.6	37.1
40	52.6	66.0	52.6	52.8	43.0	54.0	59.4	43.0	43.2	47.5
75	96.0	121.0	96.4	96.8	78.8	99.0	108.9	78.8	79.2	87.1
125	156.9	196.8	156.9	157.4	128.1	161.0	177.1	128.1	128.8	141.7

**SERVICE CONDITIONS**

Elevation ..... to 3300 ft.  
Ambient Temperature Range .....  
Cabinet ..... 0°C to 40°C (32°F to 104°F)  
Chassis ..... 0°C to 55°C (32°F to 131°F)  
Atmosphere ..... Non-Condensing Relative Humidity 5 to 95%  
A-C Line Voltage Variation ..... -5% to +10%  
A-C Line Frequency Variation ..... 50/60 Hz  $\pm$ 2 Hz  
Maximum A-C Line Distribution System KVA Capacity  
5-20 HP ..... 142 KVA (1)  
30-40 HP ..... 263 KVA (1)  
50-75 HP ..... 482 KVA (1)  
100-125 HP ..... 784 KVA (1)  
Storage Temperature ..... -40°C to 65°C (-40°F to 149°F)

**APPLICATION DATA**

Standard  
Service Factor ..... 1.0  
Maximum Load ..... 150% for one minute  
Output Regulation  
Voltage .....  $\pm$ 1%  
Frequency Stability Long Term .....  $\pm$ 0.5% of set speed  
Continuous Speed Range (2) ..... 6 to 66 Hz (2)  
Maximum Output Voltage  
460 VAC Controller ..... 460 VAC  
575 VAC Controller ..... 575 VAC

- (1) Distribution system capacity above the maximum recommended KVA requires using isolation transformer or other means of similar impedance.  
(2) Contact Reliance for assistance where operation above 70 Hz for 2 pole motors and 40 Hz for all other motors is required.  
(3) Range can be changed by jumper selection on VSAA board. Frequency ranges shown are for 60 Hz selection.  
(4) Change resistor for 2-98 seconds.  
(5) Change jumper for ramp-to-rest rather than coast-to-rest.

**ADJUSTMENTS**

Standard (Nominal Values)  
Acceleration (4) ..... 2 to 20 seconds  
Deceleration (4) (5) ..... 2 to 20 seconds  
Volts/Hertz ..... 6.4 to 19.12 V/Hz  
Voltage Offset (Fundamental RMS) ..... 0 to 37.5 volts  
Minimum Frequency(3) ..... 6 to 30 Hz  
Maximum Frequency(2)(3) ..... 30 to 60 Hz

**PRODUCT PUBLICATIONS**

General A-C V\*S Drive Bulletin ..... D-2646  
Three-Phase Input A-C V\*S Drive Data Sheet  
460 VAC Controller ..... D-2810  
575 VAC Controller ..... D-2810  
Application Manual ..... D-9084  
Wiring Diagrams  
5-20 HP ..... W/D 29594-4  
30-40 HP ..... W/D 29595-4  
75-125 HP ..... W/D 29596-4  
Wiring diagrams showing interconnections  
of all standard kits and controls ..... W/D 103774-73

# Honeywell

## DELTA 560 Data Gathering Panel

### DELTA 5600 Building Management System

#### GENERAL

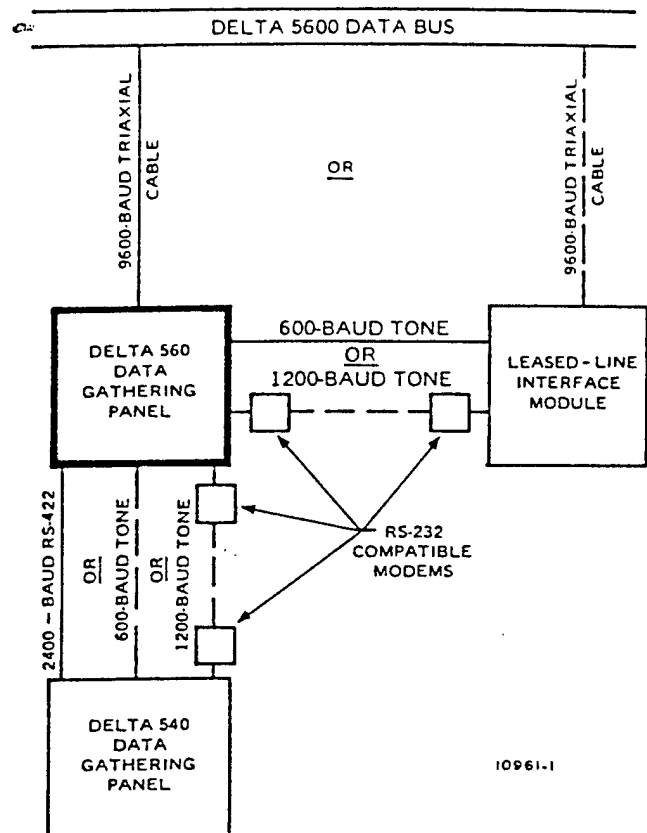
The DELTA 560 Data Gathering Panel (DGP) is an intelligent data gathering panel used in the DELTA 5600 Building Management System. It preprocesses and interfaces data from 500 or more hardware points to the DELTA 5600 Data Bus. Microprocessor-based, the DELTA 560 DGP contains its own Operating System (OS), data files, and application programs. The DGP is downline loaded from the DELTA 5600 Systems' Level 6 Minicomputer and carries out its assigned tasks under the guidance of the minicomputer. If communications with the Level 6 Minicomputer are disrupted, the DELTA 560 DGP software independently executes resident application programs. As the major data gathering panel in a DELTA 5600 System, the DELTA 560 DGP collects data from "slave" DGPs. The DELTA 5600 System slave DGP is the microprocessor-based DELTA 540 DGP. Other DELTA System DGPs used as slaves are the Series 1000, Series 1200, DELTA 2000 DGPs, and FS20A Fire and Security DGPs. The DELTA 560 DGP interfaces data from these DGPs to the DELTA 5600 Data Bus either directly or through Leased Line Interface device.

#### FEATURES

- Microprocessor-Based Intelligence
- Highly Versatile Transmission Options
- Dynamic Energy Management Capabilities
- Resident Software Provides Reliability and Efficiency

#### MICROPROCESSOR-BASED INTELLIGENCE

The microprocessor-based DELTA 560 DGP greatly enhances overall DELTA 5600 functionality. Requests or commands from either the operator or the Level 6 Minicomputer are fed to the DELTA 560 DGP via the data bus for rapid distribution to remote DGPs. Likewise, information gathered from remote points is preprocessed in the DGP and transmitted



back to the Level 6 Minicomputer via the data bus. The DELTA 560 DGP executes (on a stand-alone basis) time, event, and energy management programs that have been downline loaded from the Level 6 Minicomputer. In addition, the DGP stores multiple Change-of-State (COS) alarms and transmits them on the data bus in order of assigned priority. If communication with the Level 6 Minicomputer is disrupted, the DELTA 560 DGP continues to carry out such building management assignments as:

- Field Point Scanning
- Digital COS Detection and Reporting
- Analog Limit Alarm Detection and Reporting
- Run Time Accumulation and Demand Meter Totalizing
- Resident Energy Management Programs
- Default Mode Operation

## HIGHLY VERSATILE TRANSMISSION OPTIONS

A variety of transmission options are available to interface a DELTA 560 DGP to slave DGPs and the DELTA 5600 Data Bus. Connection to the data bus is either direct wire or through a Leased Line Interface device, as follows:

### Direct Wire

- 9600-baud via triaxial cable

### Leased Line Interface

- 600-baud tone
- 1200-baud tone via RS-232 compatible modems

Slave DGPs interface the DELTA 560 DGP using the options shown in Figure 1.

## DYNAMIC ENERGY MANAGEMENT CAPABILITIES

Downline loaded Energy Management System (EMS) execution programs allow each DELTA 560 DGP to be functionally tailored to specific energy management requirements. Programs may be assigned to operate on a stand-alone basis, completely independent of other bus-connected processors. Standard EMS options include:

- Optimum Start/Stop
- Duty Cycling
- Enthalpy Control
- Zero Energy Band

- Load Reset
- Power Demand
- Warm-Up Cycle
- Night Purge
- Night Cycle
- Lighting Control

Each DELTA 560 DGP can execute Event-Initiated Program (EIP) and DELTA FORTRAN application packages. For a full discussion of the software capabilities of the DELTA 560 DGP refer to the D5600 DELTA 560 DGP Operating System Software Specification Data Sheet, Form 74-1443.

## RESIDENT SOFTWARE PROVIDES RELIABILITY AND EFFICIENCY

The DELTA 560 DGP processes information gathered by remote DGPs and sends this processed information to the Level 6 Minicomputer. This procedure reduces bus traffic and keeps the bus available for more critical information. To do this, the DELTA 560 DGP performs a reasonableness check and a minimum change evaluation on each analog value. Unreasonable values and non-significant changes are not communicated to the Level 6 Minicomputer. Alarm limit checks also are performed by the DELTA 560 DGP. Analog values that rise above (or fall below) assigned limits and all digital alarms are reported to the Level 6 Minicomputer as priority data.



# SPECIFICATIONS

## Model:

DELTA 560 DGP

## Power Requirements (Primary):

100/120V ac + 10%, -15%, 47-63 Hz, 3.5A max  
220/240V ac + 10%, -15%, 47-63 Hz, 1.7A max

## Standby Battery:

5.5A at 24V

## Environmental Operating Limits:

Temperature: 32 to 120 F (0 to 49 C)  
Humidity: 90% rh maximum (noncondensing)

## Storage Temperature:

-9 to 165 F (-23 to 74 C)

## Program Entry:

Operating System:

PROM Resident

RAM Resident

Data File:

RAM Resident

Data File Loading:

Manual from Level 6 Minicomputer

Downline from Level 6 Minicomputer

Diskette via Techtran loader

## Transmission:

DELTA 560 DGP to DELTA 5600 Data Bus:

DC: 9600-baud over 75-ohm triaxial cable Maximum distance: 10,000 ft (3048 m); maximum DELTA 560 DGP-to-DELTA 560 DGP distance 10,000 ft (3048 m); total bus length 18,000 ft (5490 m) maximum.

Leased Line:

600-baud tone

1200-baud tone via RS-232 compatible modems

Single/dual transmission per NFPA 72D Type 1 or 2

DELTA 560 DGP-to-DELTA 540 DGP:

DC: 2400-baud, 18 AWG twisted-pair copper wire

Maximum distance: 4000 ft (1219 m) Single/dual transmission per NFPA 72D Type 1 or 2

Leased Line:

600-baud tone

1200-baud tone via RS-232 compatible modems

Single/dual transmission per NFPA 72D Type 1 or 2

DELTA 560 DGP-to-DELTA 1000 DGP:

DC: 1200-baud dc current loop, 18 AWG twisted-pair copper wire; 10,000 ft (3048 m) max

Single/dual transmission per NFPA 72D Type 1 or 2

Leased Line:

600-baud tone; Type 1 or 2

DELTA 560 DGP-to-DELTA 2000 DGP:

50,000 baud coaxial cable, 10,000 ft (3048 m) max; 20,000 ft (6096 m) max with Rengerative Repeater

DC: half duplex

## Mounting:

Full-Size Ring Cabinet

## Auxiliary Models:

DELTA 1000 Transmission Boards:

600-baud tone

RS-232

1200-baud (DC)

DELTA 2000 Interface Boards:

50,000-baud coax

DELTA 540 DGP Interface Boards:

RS-232

RS-422

DELTA 5600 Bus Interface Boards:

9600-baud triaxial

600-baud tone

1200-baud RS-232

Standby Battery

## Capacity:

300 Points (500 maximum with added memory)

DELTA 1000 DGPs:

1200-baud dc: 46 maximum

600-baud tone: 99 maximum

RS-232 modem: 99 maximum

DELTA 540 DGP:

2400-baud dc RS-422: 32 maximum per EIA Board

RS-232 compatible modem: 32 maximum per EIA Board

600-baud tone: 8 maximum

DELTA 2000 DGPs:

42 per channel

## Ring Cabinet Dimensions:

37.25 in. (946 mm) high x 24 in. (610 mm) wide x 10 in. (254 mm) deep

## Shipping Weight:

Approximately 65 lb (29.5 kg)

# Honeywell

In the USA: Honeywell Plaza, Minneapolis, Minnesota 55408

In Canada: Scarborough, Ontario

Subsidiaries and Affiliates Around the World

Printed in USA

# Honeywell

## DELTA 540 Data Gathering Panel

### DELTA 5600

### Building Management System

## GENERAL

The DELTA 540 Data Gathering Panel (DGP) is a microprocessor-based DGP. It gathers data from remote sensors and command points, and transmits this information to "intelligent" DELTA 560 DGPs. For fire and security applications, the 540 DGP interfaces FS20A DGPs to a DELTA 560 DGP. The 540 DGP performs serial-to-parallel data conversion and communicates with a 560 DGP in half- or full-duplex modes. Transmission is continuously monitored to insure operational integrity of the 540 DGP. Communication between 540 and 560 DGPs is accomplished by RS-422 digital transmission or Frequency-Shift-Keying (FSK) tone transmission via 600- or 1200-baud modems. A universal ring cabinet houses the DELTA 540 DGP.

## FEATURES

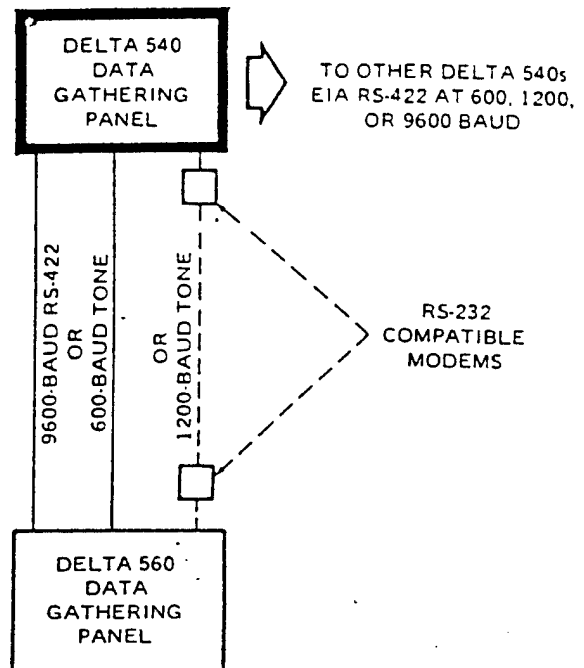
- Field-Programmable Data Files
- Programmable Interpolation Tables
- Automatic Initialization on Power-Up

### ANALOG INPUTS/OUTPUTS

Each DELTA 540 DGP has 16 analog inputs and eight analog outputs, all field-programmed. Analog inputs can monitor standard Honeywell temperature sensor signals, pressure sensor signals, resistance-to-period (R/P) signals, and industry standard voltage and current signals. The following input ranges are acceptable to a 540 DGP:

- 0 to 10 mV dc
- 0 to 100 mV dc
- 0 to 5 mA dc
- 4 to 20 mA dc
- 500-ohm Balco temperature sensor signals\*
- PT100 sensor signals\*
- RTD sensor signals (1000 to 3000 ohms)

\*Readings are linearized by four internally programmed interpolation tables.



10960

Resistive, voltage, and current inputs are continuously self-calibrated to accommodate variations in ambient temperatures and power supply fluctuations. R/P failure detection is also provided, by comparison of the R/P input range to a preprogrammed range. Balco temperature sensors, PT100 devices, and RTD devices are linearly compensated by four interpolation tables programmed into the DELTA 540 DGP data file. Analog inputs to the 540 DGP are scanned and digitized, and have a 12-bit resolution. The converted digital value is held in the 540 DGP's memory for transmission to the DELTA 560 DGP.

Digital data from the 560 DGP is used to control analog outputs of the 540 DGP. These digital controlled analog outputs are programmed for direct conversion to standard 4 to 20 mA, 0 to 10V, or 4 to 7V signals. All digital-to-analog conversions have a 10-bit resolution. Using the 0 to 10V signal and a pneumatic transducer, a 3 to 13 lb/in<sup>2</sup> (21 to 90 kPa) pneumatic proportional signal can be obtained for driving pneumatic devices.

Setpoint adjustments are treated as analog outputs by the DELTA 540 DGP. They can be programmed to provide a voltage output to control electric or pneumatic devices.

Totalizer inputs monitor contact closures that occur at a rate of up to 10 closures per second. DELTA 540 DGPs used in totalizer applications contain standby battery power to retain totalizer values in the case of ac power failure.

## DIGITAL INPUTS/OUTPUTS

The 540 DGP monitors the status of up to 24 digital inputs. Sixteen digital outputs are available for control of momentary, maintained, universal, or magnetic latch relays. These relays are available in plug-in, remote, or stand-alone panel-mounted configurations. Momentary digital operations are point-programmable, with an actuation time range of 0.1 to 1.0 seconds.

## POWER REQUIREMENTS

The DELTA 540 DGP is powered either by 24V ac, 50/60 Hz, supplied from a transformer or from 24V dc supplied by the DELTA 560 DGP or a separate 24V dc power supply. Power supplies are sized to accommodate all accessory devices (such as relays and analog output devices) used in the same enclosure with the DELTA 540 DGP. Optional battery backup also is available for the DGP.

## SPECIFICATIONS

### Model:

DELTA 540 DGP

### Input/Output Capacity:

Digital/Analog DELTA 540 DGP: 66 Input/Output capacity

Digital DELTA 540 DGP: 42 Input/Output capacity

### Power Requirements (Primary):

24V dc, 1A maximum  
120V ac, 50/60 Hz, 0.2A maximum  
24V ac, 50/60 Hz, 1A maximum

### Standby Battery:

5.5A at 24V

### Environmental Operating Limits:

Temperature: 32 to 120 F (0 to 49 C)  
Humidity: 95% rh maximum (noncondensing)

### Storage Temperature:

-9 to 165 F (-23 to 74 C)

### DGP Initialization:

Automatically completed within 10 seconds after power on

### Data File Entry:

Data file is PROM resident and is field entered via DELTA 560/540 DGP Test Set

### Transmission:

DELTA 560 DGP-to-DELTA 540 DGP:

DC: RS-422 9600-baud, 18 AWG (1 mm), twisted-pair copper wire

Maximum Distance: 4000 ft (1219 m)

Single/dual transmission per NFPA 72D Type 2 or 1

Leased Line:

600-baud tone

1200-baud tone via RS-232 compatible modems

Single/dual transmission per NFPA 72D Type 2 or 1

### Mounting:

Full-Size Universal Ring Cabinet

Half-Size Universal Ring Cabinet

### Dimensions:

Full-Size Universal Cabinet: 37 in. (940 mm) high x 24 in. (610 mm) wide x 9 in. (229 mm) deep

Half-Size Universal Cabinet: 18-5/8 in. (473 mm) high x 24 in. (610 mm) wide x 9 in. (229 mm) deep

Full-Size Subpanel: 36 in. (914 mm) high x 19 in. (483 mm) wide x 6-1/2 in. (165 mm) deep

Half-Size Subpanel: 17-1/2 in. (444 mm) high x 19 in. (483 mm) wide x 6-1/2 in. (165 mm) deep

# Honeywell

In the USA: Honeywell Plaza, Minneapolis, Minnesota 55408

In Canada: Scarborough, Ontario

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## System 20/20 Zone Sensor

### Description

Zone sensors are two wire, 4-20 mA devices with a precalibrated range of 45-96 °F. They utilize power from the module terminations; thus no external power supply is required. The sensor is an Analog Devices AD590 solid-state transducer which converts degrees Kelvin into microamps in an absolute linear fashion, thus requiring no hardware linearization, software look-up tables, or 'best fit' gain approximations.

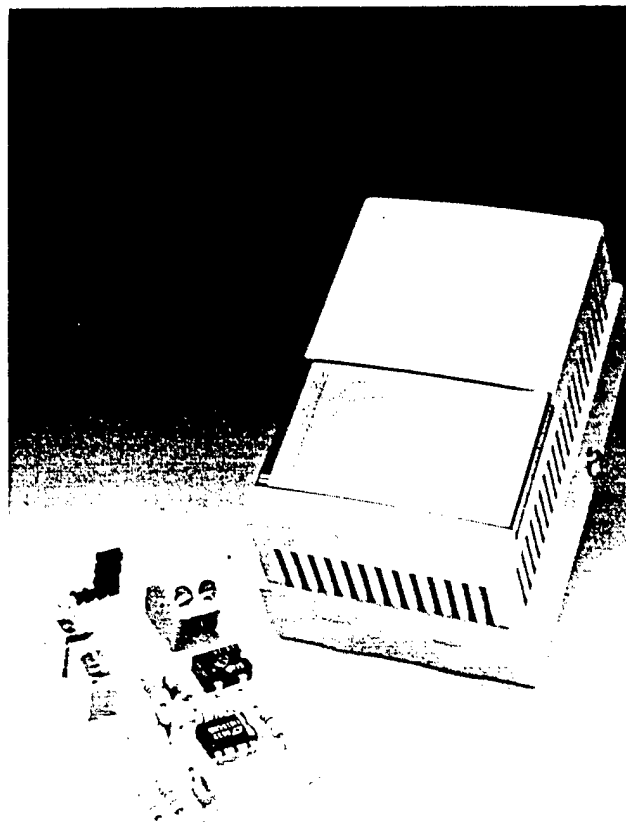
The transmitter consists of an accurate temperature compensated reference and a current amplifier to boost the signal to the standard 4-20 mA. A bridge circuit is incorporated which permits connection with no concern for polarity. The units are calibrated and sealed at the factory to assure accuracy within the precalibrated range.

This sensor is available in both surface and flush mount models. The surface unit mounts directly to the wall with screws or fits conveniently in a Wiremold surface box. The formed plastic cover is perforated to permit air flow around the sensor element.

The flush unit installs in a standard 2 1/4" x 4" electrical switch box. It is provided with a cover plate which makes direct contact with the sensor element and is insulated from the wall surface with a foam insulating shield.

### Specifications

- Range: 45-96 °F.
- Output: 4 mA at 45° F, 20 mA at 96 °F, linear over the complete range.
- Voltage (from modules): 12-24 VDC.
- Wiring: 18 gauge twisted pair.
- Mounting method: Screws through pre-punched holes for direct surface mount, pre-mounted to back plate for flush mount.
- Dimensions are 2 1/4" wide x 3 1/2" high x 1 1/2" deep.
- Listed by Electronics Testing Laboratories (ETL).



### OFFSET & GAIN SETTINGS

Range	45 - 96 °F
Resolution	1/4 °F
Offset	32.25
Gain	0.25

## System 20/20 Immersion Sensor

### Description

Immersion sensors are two wire, 4-20 mA devices with several precalibrated ranges. They utilize 12 VDC loop power from the ALC module terminations; thus no external power supply is required. The sensor is an Analog Devices AD590 solid-state transducer which converts degrees Kelvin into microamps in an absolute linear fashion, thus requiring no hardware linearization, software look-up tables, or 'best fit' gain approximations.

The transmitter consists of an accurate temperature compensated reference and a current amplifier to boost the signal to the standard 4-20 mA. A bridge circuit is incorporated which permits connection with no concern for polarity. The units are calibrated and sealed at the factory to assure accuracy within the precalibrated ranges.

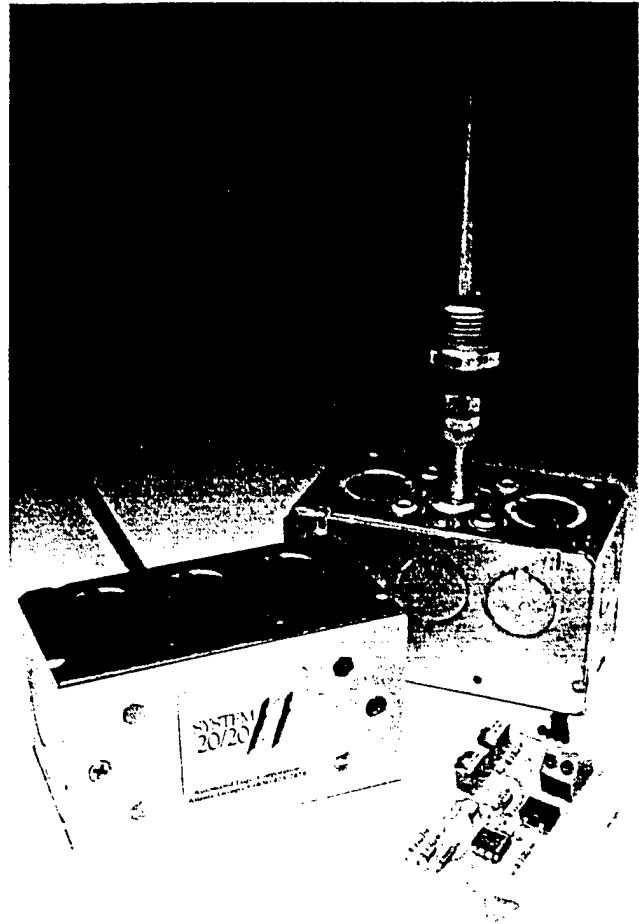
The probe is 6" long and by use of its compression fitting will fit in both 4" and 6" immersion wells. The compression fitting screws directly into the brass wells. Wells are threaded into half couplings welded to the pipe. The steel junction box has preformed knock-outs for conduit connections if required. The sensor is also available in a weatherproof enclosure with a 5 1/2" probe.

### Specifications

- Ranges: 30-81, 32-134, 80-233, 30-234, and 32-185 °F.
- Output (all ranges): 4 mA at low end, 20 mA at high end, linear.
- Voltage Requirement (from modules): 12 VDC.
- Wiring: 18 gauge twisted pair.
- Dimensions: 4" x 2 1/4" x 2" box with 6" probe.
- Dimensions (weatherproof enclosure): 4 1/2" x 2 1/4" x 2 1/2" box with 5 1/2" probe above 1/2" nipple.
- Listed by Electronics Testing Laboratories (ETL).

### OFFSET & GAIN SETTINGS

Range	30 - 81 °F	32 - 134 °F	80 - 233 °F	30 - 234 °F	32 - 185 °F
Resolution	1/4 °F	1/2 °F	3/4 °F	1 °F	3/4 °F
Offset	17.25	6.50	41.75	- 21.00	- 6.25
Gain	0.25	0.50	0.75	1.00	0.75



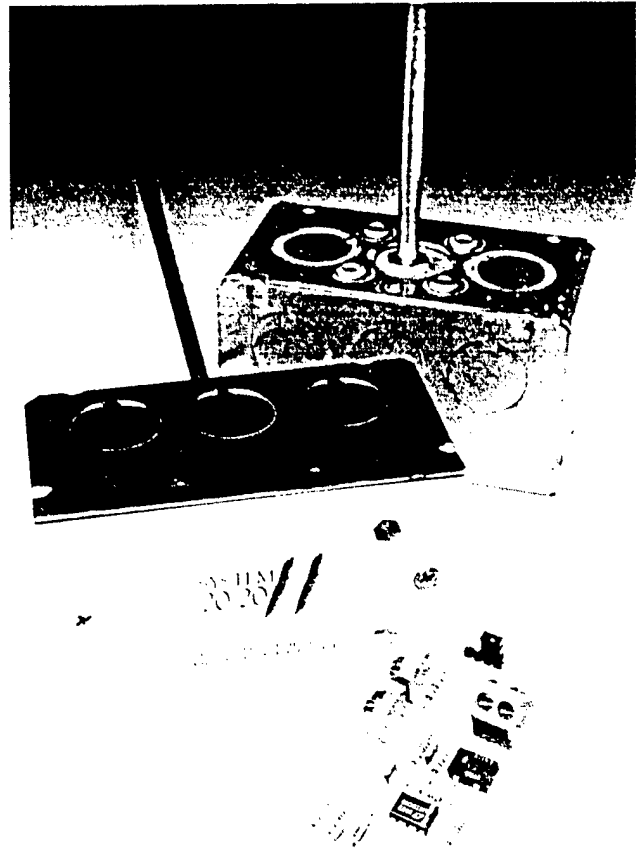
## System 20/20 Duct Sensor

### Description

Duct Sensors are two wire, 4-20 mA devices with several precalibrated ranges. They utilize 12 VDC loop power from the module terminations; thus no external power supply is required. The sensor is an Analog Devices AD590 solid-state transducer which converts degrees Kelvin into microamps in an absolute linear fashion, thus requiring no hardware linearization, software look-up tables, or 'best fit' gain approximations.

The transmitter consists of an accurate temperature compensated reference and a current amplifier to boost the signal to the standard 4-20 mA. A bridge circuit is incorporated which permits connection with no concern for polarity. The units are calibrated and sealed at the factory to assure accuracy within the ranges listed above.

The unit mounts directly to the wall of the duct. The steel junction box has pre-formed knock-outs for conduit connections if required.



### Specifications

- Ranges: 30-81, 32-134, 80-233, 30-234, and 32-185 °F.
- Output (all ranges): 4 mA at low end, 20 mA at high end, linear.
- Voltage (from modules): 12 VDC.
- Mounting Method: Screws through pre-punched holes.
- Wiring: 18 gauge twisted pair.
- Dimensions: 2 1/4" x 4" x 2 3/4" box with 8 3/4" probe.
- Listed by Electronics Testing Laboratories (ETL).

### OFFSET & GAIN SETTINGS

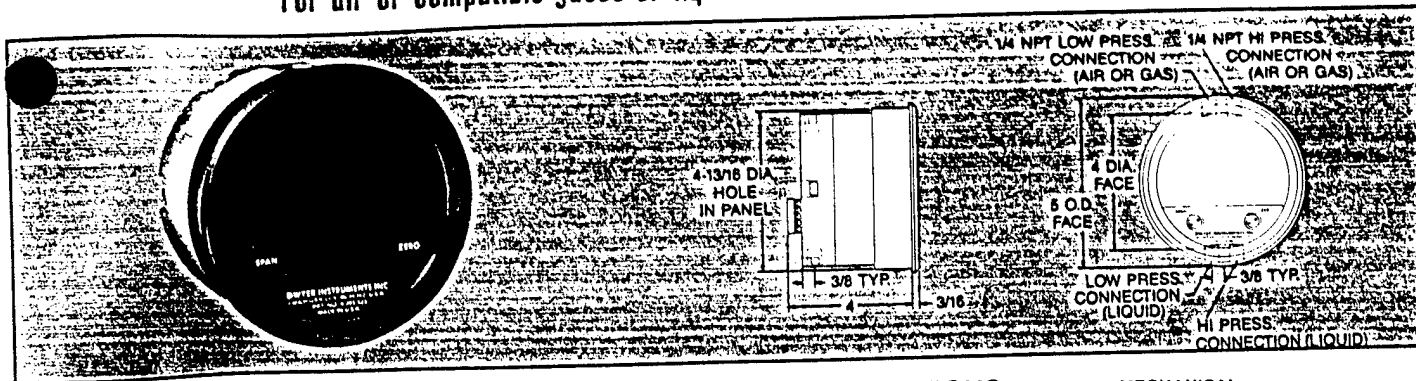
Range	30 - 81 °F	32 - 134 °F	80 - 233 °F	30 - 234 °F	32 - 185 °F
Resolution	1/4 °F	1/2 °F	3/4 °F	1 °F	3/4 °F
Offset	17.25	6.50	41.75	- 21.00	- 6.25
Gain	0.25	0.50	0.75	1.00	0.75



SERIES  
630

# Differential Pressure Transmitter

For air or compatible gases or liquids. Pressure rated to 500 psig. 4-20 mA signal.



The Dwyer Series 630 differential pressure transmitter features a heavy forged brass case which makes it suitable for use with water while allowing maximum rated pressure of 500 PSIG. Screw type terminal strip is located on back and duplicate pressure connections are located on top and bottom. Accuracy  $\pm 3\%$ . Output signal is 4-20 mA.

SERIES 630 TRANSMITTER MODELS & RANGES

MODEL NUMBER	RANGES IN INCHES OF WATER		
	AS STOCKED	MIN. RANGE	MAX. RANGE
630-1	0-0.50	0-0.25	0-1.00
630-2	0-2.00	0-1.00	0-3.50
630-3	0-5.00	0-2.50	0-20
630-4	0-25	0-20	0-50
630-5	0-100	0-50	0-300

## SPECIFICATIONS

### GENERAL

Maximum Pressure: Operating 500 PSIG

Media Compatibility: Non-combustible, non-corrosive, compatible gases or fluids. DO NOT use with hydrogen gas.

### ELECTRICAL

Power Supply: 20-30 VDC; 18-26 VAC

Electrical Connections: 5 screw terminal strip

Output Signal: 4-20 mA DC, 3 or 4 wire (limited at 30 mA)

Loop Resistance:

3 wire - 250-1200 ohms at 30 VDC

4 wire - 0-500 ohms at 20-30 VDC

4 wire current sourcing 150-1400 ohms at 10-35 VDC

Current Consumption: Min. 100 mA DC, Min. 200 mA AC

### MATERIALS

Forged brass case, acrylic cover, die cast aluminum bezel with baked dark gray hammerloid finish.

### MECHANICAL

Weight: 7 lb., 13 oz.

Span and Zero Adjustments:

Protected potentiometers

Pressure Connections:  $\frac{1}{4}$ " NPT high and low pressure taps, duplicated one pair top and one pair bottom.

### PERFORMANCE AT 70°F

Zero Output: 4 mA

Full Span Output: 20 mA

Accuracy (includes linearity, hysteresis, repeatability):  $\pm 3\%$  of full span output

Warm-up Time: 30 minutes

### ENVIRONMENTAL

Operating Temperature:

32°-120°F (0-50°C)

### STANDARD ACCESSORIES

Two  $\frac{1}{4}$ " NPT plugs for duplicate pressure taps, snap rings, mounting ring, four (4) #6-32 x  $\frac{1}{4}$ " mounting screws, span and zero adjust key.

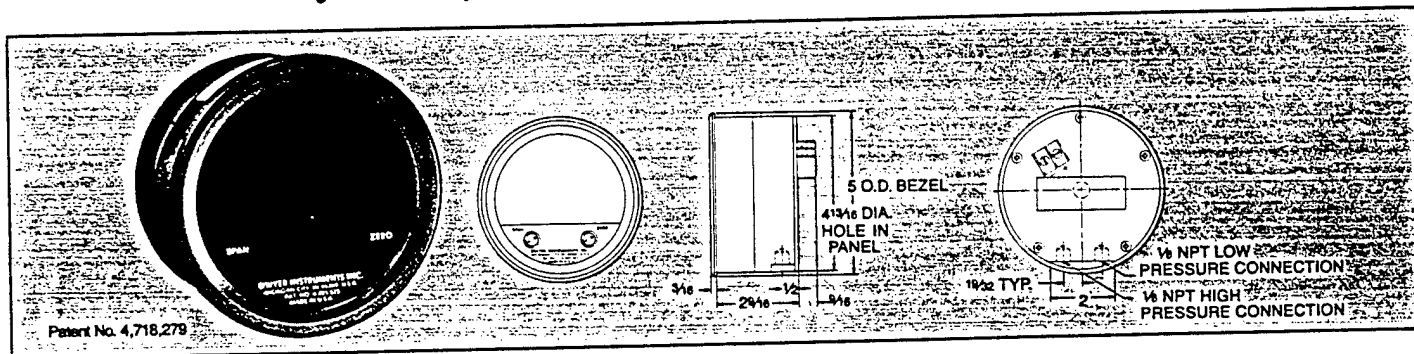
(See page 14 for Suggested Specifications.)



SERIES  
632

# Differential Pressure Transmitter

Ranges to 200 psid. For compatible liquids or gases. 4-20 mA signal.



The Dwyer Series 632 two-wire differential pressure transmitter provides the capability for monitoring and controlling high positive, negative or differential pressures from 30-200 psi. The unique design features twin spirally wound Bourdon tubes operating against a calibrated range spring/strain gage assembly. The small volume and virtually no moving parts means maximum reliability under shock and vibration. Linearity and repeatability are excellent at low cost. The two-wire, 4-20 mA output simplifies installation. External tamper-proof zero and span adjustments are provided with electrical connections made to a standard connector on the rear of the housing.

SERIES 632 TRANSMITTER MODELS & RANGES

MODEL NUMBER	RANGES IN PSI		
	AS STOCKED	MIN. RANGE	MAX. RANGE
632-1	0-30 psi	0-30 psi	0-200 psi

## Specifications

### GENERAL

Maximum Pressure: 500 psig

Media Compatibility: Air and compatible gases and liquids

### ELECTRICAL

Power Supply: 12.3 to 35 VDC

Output Signal: 4 to 20 mA DC, 2 wire (limited at 38 mA max.)

Loop Resistance: 0-1135 ohms from 12.3-35 VDC

Current Consumption: 38 mA DC (max.)

### MATERIALS

Wetted: Brass and beryllium copper

Other: Die cast aluminum case with baked dark gray hammerloid finish, acrylic cover

### MECHANICAL

Weight: 2 lb., 8 oz.

Span and Zero adjustments:

Protected potentiometers

Pressure connections:  $\frac{1}{8}$ " NPT female high and low pressure taps on bottom

### PERFORMANCE AT 70°F

Zero output: 4 mA

Full span output: 20 mA

Accuracy (includes linearity, hysteresis, repeatability):  $\pm 2\%$  of full span output

Span and Zero: Adjustable to 0.05% of full span

Warm-up time: 10 minutes

### ENVIRONMENTAL

Operating temperature: 20° to 120°F  
Thermal Error:  $\pm 1\%/50^\circ\text{F}$  typical

### STANDARD ACCESSORIES

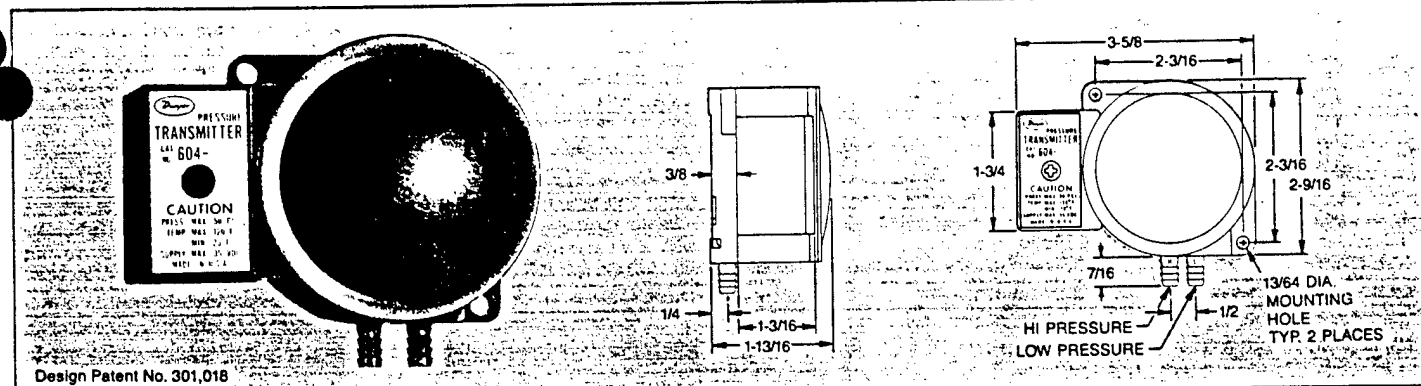
Span and zero adjust tool, mounting hardware kit



SERIES  
604

# Differential Pressure Transmitter

4-20 mA signal. Two wire operation. Pressure rated to 30 psig.



The Dwyer Series 604 2-Wire differential pressure transmitter offers very low ranges down to 0-0.1" w.c. yet withstands continuous pressure to 30 PSIG. The tough filled Nylon housing features simple surface mounting arrangement and barbed connections. The units are compact and lightweight yet provide overall accuracy of  $\pm 2\%$ . Output signal is 4-20 mA. Zero and span adjustments plus terminal block connections are easily accessible but protected in auxiliary housing.

## SERIES 604 TRANSMITTER MODELS & RANGES

MODEL NUMBER	RANGES IN INCHES OF WATER		
	AS STOCKED	MIN. RANGE	MAX. RANGE
604-0	0-0.5	0-0.1	0-1.0
604-1	0-2.0	0-0.5	0-4.0
604-2	0-10	0-2.0	0-20
604-3	0-50	0-15	0-120

## SPECIFICATIONS

### GENERAL

Maximum Pressure: 50 PSIG surge,  
30 PSIG continuous to either  
pressure connection.

Media Compatibility: Air & non-  
combustible, non-corrosive gases.

### ELECTRICAL

Power Supply: 12.3 to 35 VDC  
Output Signal: 4 to 20 mA DC, 2 wire  
(limited at 38 mA max.)

Loop Resistance: 0-1135 ohms from  
12.3 to 35 VDC

Current Consumption: 38 mA DC  
(max.)

### MATERIALS

Mineral and glass filled nylon housing,  
high impact acrylic cover, silicone  
rubber diaphragm.

### MECHANICAL

Weight: 6 ozs.

### Span and Zero Adjustments:

Protected potentiometers, accessed  
by removal of auxiliary housing  
cover (#2 Phillips head screw).

Pressure Connections: Barbed, for  
 $\frac{3}{16}$ " I.D. tubing.

### PERFORMANCE AT 70°F

Zero Output: 4 mA DC

Full Span Output: 20 mA DC

Accuracy (includes linearity,  
hysteresis, repeatability):  $\pm 2\%$  of  
full span output

Span & Zero: Adjustable to 0.05% of  
full span

Warm-up Time: 10 minutes

### ENVIRONMENTAL

Operating Temperature: 20° to 120°F

Thermal Errors:  $\pm 1\%/50^\circ\text{F}$  typical

### STANDARD ACCESSORIES

Mounting screws (2), #10 x 1" long  
pan head sheet metal screws.

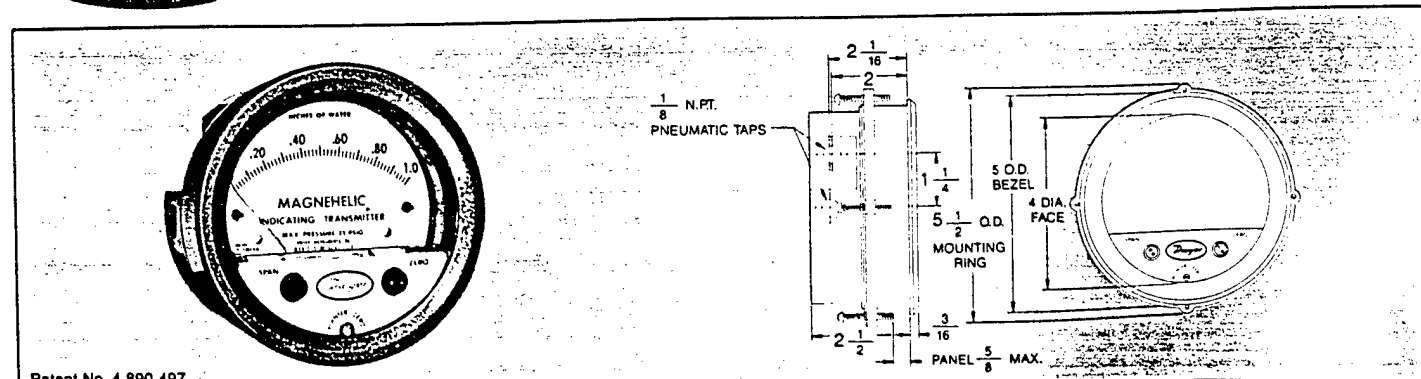
(See page 14 for Suggested Specifications.)



SERIES  
605

# Magnehelic® Differential Pressure Indicating Transmitter

Dial Gage Indication,  
Two-Wire 4-20 mA Output



The Dwyer Series 605 Magnehelic® Indicating Transmitter provides for both visual monitoring and electronic control of very low differential pressure. The Series 605 is ideal for control applications in building HVAC systems where local indication is desired during routine maintenance checks or necessary when trouble shooting the system. The easily read dial gage is complemented by the two-wire, 4-20 mA control signal utilizing the time-proven Dwyer Magnehelic® gage mechanical design and Series 600 strain-gage transmitter technology. The two-wire design with terminal strip on the rear simplifies connection in any 4-20 mA control loop powered by a 12.3-35 VDC supply.

## SERIES 605 MODELS & RANGES

MODEL NUMBER	RANGE, INCHES W.C.	MINOR DIVISIONS	MODEL NUMBER	RANGE, PASCALS	MINOR DIVISIONS
605-0	0-5	.01	605-250 Pa	0-250	5
605-1	0-1	.02	605-500 Pa	0-500	10
605-2	0-2	.05			
605-3	0-3	.1	MODEL NUMBER	RANGE, KILOPASCALS	MINOR DIVISIONS
605-6	0-6	.2	605-1.5 kPa	0-1.5	0.5
605-10	0-10	.2			
605-20	0-20	.5			
605-30	0-30	1.0			
605-50	0-50	1.0			

## SPECIFICATIONS

### GENERAL

Maximum Pressure: 25 PSIG

Media Compatibility: Air & non-  
combustible, non-corrosive gases.

### ELECTRICAL

Power Supply: 12.3 to 35 VDC  
Output Signal: 4 to 20 mA DC, 2 wire  
(limited at 38 mA max.)

Loop Resistance: 0-1135 ohms from  
12.3 to 35 VDC

Current Consumption: 38 mA DC  
(max.)

### MATERIALS

Die cast aluminum case with  
baked dark gray hammerloid finish,  
acrylic cover

### MECHANICAL

Weight: 2 lb., 8 oz.

### Span and Zero adjustments:

Protected potentiometers

Pressure connections:  $\frac{1}{8}$ " NPT  
female high and low pressure taps

### PERFORMANCE AT 70°F

Zero output: 4 mA

Full span output: 20 mA

Accuracy (includes linearity,  
hysteresis, repeatability):  $\pm 2\%$   
of full span output

Span and Zero: Adjustable to 0.05% of  
full span

Warm-up time: 10 minutes

### ENVIRONMENTAL

Operating temperature: 30° to 120°F

Thermal Errors:  $\pm 1\%/50^\circ\text{F}$  typical

### STANDARD ACCESSORIES

Span and zero adjust tool, mounting  
hardware kit

(See page 14 for Suggested Specifications.)

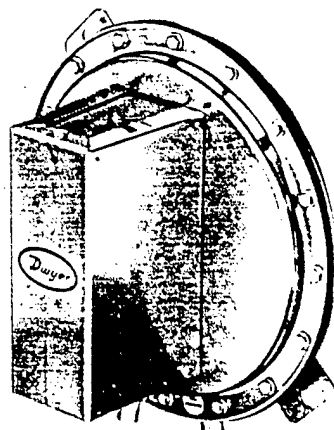




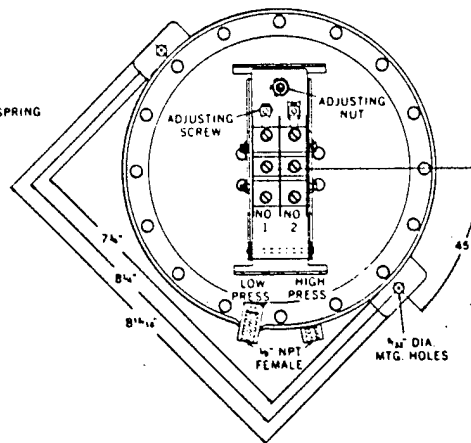
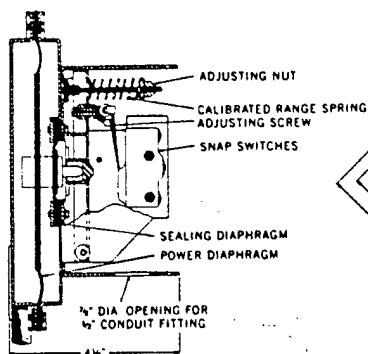
SERIES  
1620

# Single and Dual Pressure Switches

High reliability...repetitive accuracy within 1%



Series 1620 Pressure Switch



Dimensions and construction detail. Shown is model 1627. Model 1626 is identical except has single snap switch on right side.

Our old faithful switch design is still best where highest precision combined with diaphragm sealed leak proof construction and mounting simplicity is required. Model 1626 and 1627 differential pressure switches are identical in design and construction except that Model 1626 has a single electric switch and Model 1627 has dual electric switches. Model 1627 can therefore provide dual control when required. It can be set to open or close two independent electrical circuits, each preset for its own actuation pressure. Both units have diaphragm sealed motion take outs providing maximum protection against leakage.

## SPECIAL MODELS AVAILABLE

(See page 2 for OEM models).

**Environmental (MIL) Construction.** Can be furnished with a special snap switch sealed against the environment for high humidity, exposure to fungus, and/or for military applications. Dead band is slightly greater and some lower set points may not be available. Specify Model 1626 or 1627 - (Range No.) - "MIL" and required set point in ordering.

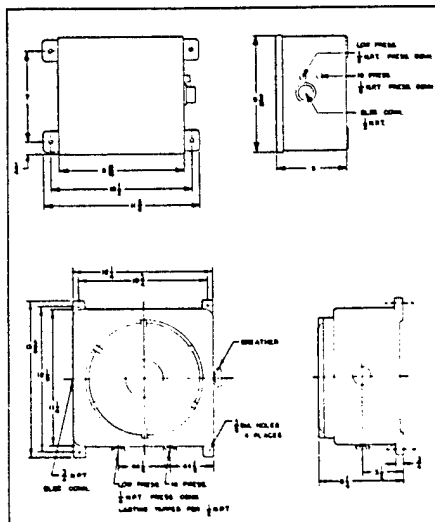
## HOUSINGS FOR USE WITH SERIES 1620 SWITCHES

### Weatherproof Housing

16-ga. steel enclosure for unusually wet or oily conditions. Withstands 200 hour salt spray test. Gasketed cover. Weight, 20 lbs. Switch must be installed at factory. Specify "WP" in addition to switch catalog number.

### Explosion-proof Housing

Millark cast alum. hous. No. GRH with flat cover for No. 1626 and 1627 switches rated for Class I, Group D; Class II, Groups E, F and G and Class III. Approximate weight, 47 lbs. Specify "EXPL" in addition to switch catalog number.



## PHYSICAL DATA

Temperature limits: -30°F for dry air or gas to 130°F.

Maximum surge pressure: 2 psig.

Rated pressure: 50 in. W.C.

Pressure connections: 1/8" NPT.

Electrical ratings: 15 amps, 120-480 volts, 60 Hz A.C. Resistive, 1/8 H.P. @ 125 volts, 1/4 H.P. @ 250 volts, 60 Hz A.C.

Wiring connections: 3 screw type, each switch, common, normally open and normally closed.

Housing: 16 ga. steel, zinc plated, dichromate dipped for 200 hour salt spray test.

Power diaphragm: Silicone rubber with aluminum support plate.

Sealing diaphragm: Silicone rubber with aluminum support.

Calibration spring: Stainless steel.

Weight: Model 1626, 3 lbs., 9 oz.;

Model 1627, 3 lbs., 10 oz.

Installation: Diaphragm vertical.

CAUTION: FOR USE ONLY WITH AIR OR COMPATIBLE GASES.

## MODEL 1626 AND MODEL 1627 DUAL SWITCHES: OPERATING RANGES, DEAD BANDS AND RATINGS.

Model Number (1626 shown, 1627 similar)	Operating Range Inches, W.C.	Approx. Dead Band Min. Max.	Adj. Diff. Between Set Points (1627 only)
1626-1	.15 to 1.5	.10 .20	0.5
1626-5	.5 to 6.0	.15 .35	1.2
1626-10	2.0 to 11	.25 .65	2.3
1626-20	8.0 to 24	.50 1.20	5.0

## Suggested Specification

Differential pressure switches shall be diaphragm operated to actuate a single pole double throw snap switch (or two SPDT snap switches for Model No. 1627). Motion of the diaphragm shall be restrained by a calibrated spring that can be adjusted to set the exact pressure differential at which the electrical switch will be actuated. Motion of the diaphragm shall be transmitted to the switch button by means of a direct mechanical linkage. Switches shall be Dwyer Instruments, Inc. Catalog No. \_\_\_\_\_ for the required operating ranges.

How to Order: See price list, Bulletin S-26. 4-391

## 5 IMPROVE COMMISSARY LIGHTING EFFICIENCY

The ECO evaluation consisted of determining appropriate lighting replacements to improve lighting system efficiency at the Commissary while achieving recommended illumination levels. The ECO includes comprehensive fluorescent lighting replacements.

<b>TABLE 5.1</b>	
<b>LIGHTING SYSTEM REPLACEMENTS</b>	
<b>ECO 11</b>	
<b>EXISTING LIGHTING</b>	<b>REPLACEMENT LIGHTING</b>
T-12 Fluorescent Fixture	T-8 Fluorescent Fixture with reflector
T-12 Lamp	T-8 Lamp
Magnetic Ballast	Electronic Ballast

This section contains the analysis results for the study on improved lighting efficiency at the Commissary. Included in this section are the life cost analysis, cost estimate, and energy calculations for the project.

The life cycle analysis, Sections 3A and 3B, refers to non-energy savings or costs present. For this project, Section 3A, Annual Recurring, reflects maintenance savings available by replacing the existing lighting systems. The new fixtures, due to the use of reflectors, have fewer lamps which saves on material and labor replacement.

Section 3B, Non-Recurring Savings/Costs, refers to the replacement of parts of the existing lighting system. Many fluorescent fixtures surveyed were approaching the end of their economic life. On the spreadsheets included for fluorescent fixture replacement for each building, the higher wattage fixture for each type was replaced in this section.

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.072  
 INSTALLATION & LOCATION: FT CAMPBELL REGION NOS. 4 CENSUS: 3  
 PROJECT NO. & TITLE: 011-2702 INTERIOR LIGHTING / COMMISSARY  
 FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING  
 ANALYSIS DATE: 09-28-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

1. INVESTMENT

A. CONSTRUCTION COST	\$	117744.	
B. SIOH	\$	6476.	
C. DESIGN COST	\$	6476.	
D. TOTAL COST (1A+1B+1C)	\$	130696.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		130696.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 6.18	3078.	\$ 19022.	11.77	\$ 223889.
B. DIST	\$ 4.98	0.	\$ 0.	13.83	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	16.15	\$ 0.
D. NAT G	\$ 4.00	0.	\$ 0.	15.34	\$ 0.
E. COAL	\$ .00	0.	\$ 0.	12.82	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 14560.	11.12	\$ 161907.
N. TOTAL		3078.	\$ 33582.		\$ 385797.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	11.12	\$ 910.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 10119.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPLACE	\$ 81180.	8	.73	59261.
d. TOTAL	\$ 81180.			59261.

LIFE CYCLE COST ANALYSIS SUMMARY  
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
 INSTALLATION & LOCATION: FT CAMPBELL REGION NOS. 4 CENSUS: 3  
 PROJECT NO. & TITLE: 011-2702 INTERIOR LIGHTING / COMMISSARY  
 FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING  
 ANALYSIS DATE: 09-28-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)	\$	69381.
4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$	\$	39904.
5. SIMPLE PAYBACK PERIOD (1G/4)		3.28 YEARS
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)	\$	455177.
7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= (IF < 1 PROJECT DOES NOT QUALIFY)		3.48
8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):		13.02 %

# FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 11: INTERIOR LIGHTING AT THE COMMISSARY

30 SEPTEMBER 1993

## BUILDING WIDE FLUORESCENT FIXTURE REPLACEMENT

BUILDING #: 2702

BUILDING USE:

HOURS/DAY 24

DAYS/WEEK 7

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

### EXISTING FIXTURE DATA

#### 4 FOOT

1 LAMP @ 48 W/FIXT = 0 WATTS  
 1 LAMP @ 37.8 W/FIXT = 0 WATTS  
 10 2 LAMP @ 96 W/FIXT = 960 WATTS  
 2 LAMP @ 75.6 W/FIXT = 0 WATTS  
 3 LAMP @ 144 W/FIXT = 0 WATTS  
 3 LAMP @ 113.4 W/FIXT = 0 WATTS  
 132 4 LAMP @ 192 W/FIXT = 25344 WATTS  
 81 4 LAMP @ 151.2 W/FIXT = 12247. WATTS

#### 2 FOOT

1 LAMP @ 31 W/FIXT = 0 WATTS  
 4 LAMP @ 88 W/FIXT = 0 WATTS  
 2 LAMP U @ 96 W/FIXT = 0 WATTS  
 2 LAMP U @ 75.6 W/FIXT = 0 WATTS

#### 8 FOOT

395 2 LAMP @ 254 W/FIXT = 100330 WATTS  
 2 LAMP @ 188 W/FIXT = 0 WATTS

TOTAL EXISTING KW 139

BASELINE ENERGY CONSUMPTION 4140 MBTU

### REPLACEMENT FIXTURE DATA

#### 4 FOOT

0.1 LAMP @ 37 W/FIXT = 0 WATTS  
 10 1 LAMP W/ REFLECTORS 37 W/FIXT = 370 WATTS  
 0.2 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS  
 213 2 LAMP W/ REFLECTORS 58 W/FIXT = 12354 WATTS

#### 2 FOOT

0.1 LAMP @ 24 W/FIXT = 0 WATTS  
 0.2 LAMP W/ REFLECTORS 41 W/FIXT = 0 WATTS  
 0.2 LAMP U @ 58 W/FIXT = 0 WATTS

#### 8 FOOT

395 1 LAMP W/ REFLECTORS 58 W/FIXT = 22910 WATTS

TOTAL REPLACEMENT KW 36

REPLACEMENT ENERGY CONSUMPTION 1062 MBTU

NET ENERGY SAVINGS 3078 MBTU/YR

NET DOLLAR SAVINGS \$33,662.62

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 12:28:00

TITLE PAGE

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ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-11: BUILDING 2702

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
COMPOSER Plus Copyright (C) 1985, 1988  
by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 270211

5-5

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-11: BUILDING 2702

TIME 12:28:00

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DETAILED ESTIMATE

DETAIL PAGE

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AA. ELECTRICAL.....	1

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U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-11: BUILDING 2702  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:28:00

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING										
16512 7000 FLDORSCENT - RECESSED T8 ELECTRONIC BALLAST										
CD=3 EL 7002	4 FT 1 LAMP PARABOLIC LOUVRE W/ REFLECTOR	*** UNIT COSTS: ***			0.54	17.84	0.07	122.00	6.10	146.01
WC=1100		10.00 EA EELEB		5		178	1	1,220	61	1,460
CD=3 EL 7003	4 FT 2 LAMP PARABOLIC LOUVRE W/ REFLECTOR	*** UNIT COSTS: ***			0.59	19.42	0.08	136.00	6.80	162.29
WC=1100		213.00 EA EELEB		125		4,136	16	28,968	1,448	34,569
CD=3 EL 7007	8 FT 1 LAMP W/ REFLECTOR	*** UNIT COSTS: ***			0.54	17.84	0.07	109.00	5.45	132.36
WC=1100		395.00 EA EELEB		214		7,048	28	43,055	2,153	52,283
TOTAL DIVISION 16 ELECTRICAL					344	11,362	44	73,243	3,662	88,312
TOTAL FACILITY AA. ELECTRICAL					344	11,362	44	73,243	3,662	88,312
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					344	11,362	44	73,243	3,662	88,312
TOTAL BASE BID					344	11,362	44	73,243	3,662	88,312
TOTAL ADDITIVE					0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY					344	11,362	44	73,243	3,662	88,312

\* \* \* END OF DETAIL REPORT \* \* \*



Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-11: BUILDING 2702

TIME 12:28:00

PROJECT NOTES

SUMMARY PAGE 1

---

PROJECT NOTES

ECO-11: INTERIOR LIGHTING AT THE COMMISSARY

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY INTERIOR LIGHTING IN  
AT THE FT CAMPBELL COMMISSARY.

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE									BASE BID
ID	FACILITY	COST TO PRM	OVERHEAD	HOME OPC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL	1.00 EA	88,312	10.0% 8,831	0.0% 0	7.5% 7,286	2.5% 2,611	0.0% 0	107,040 107039.69
BID ITEM TOTAL		1.00 EA	88,312	8,831	0	7,286	2,611	0	107,040 107039.69
TOTAL BASE BID			88,312	8,831	0	7,286	2,611	0	107,040
TOTAL ADDITIVE			0	0	0	0	0	0	0
TOTAL INCL ADD			88,312	8,831	0	7,286	2,611	0	107,040

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U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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PROJECT CWE SUMMARY

SUMMARY PAGE 3

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	107,040		107,040	107039.70
	TOTAL CURRENT CONTRACT COST			107,040	0	107,040	
	Cost Growth from 09/93 to 09/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			107,040	0	107,040	
	Government-Furnished Property			0		0	
	SUBTOTAL			107,040	0	107,040	
	Contingencies	10.0%		10,704	0	10,704	
	SUBTOTAL			117,744	0	117,744	
	SIOH (S&A)	5.5%		6,476	0	6,476	
	CURRENT WORKING ESTIMATE			124,220	0	124,220	
	Estimated Construction Time	365	Days				

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U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 4

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT **	* SUBCON *	W/OH&P	SUBTOTAL
										AMOUNT	PCT		
AA	GENERAL/PRIME		1.00	EA	344	11,362	44	76,905		88,312	100.0%	0	88,312
	TOTAL DIRECT				344	11,362	44	76,905		88,312	100.0%		

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-11: BUILDING 2702

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CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PH	SUBTOTAL	*** OVERHEAD *** AMOUNT PCT	HOFC%	**** PROFIT **** AMOUNT PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT PCT	UNIT COST
AA	GENERAL/PRIME		88,312	8,831 10.0%	0.0	7,286 7.5%	2.5%	0.0%	107,040 100.0%	107039.69
	TOTAL OVERHEAD & PROFIT			8,831 10.0%		7,286 7.5%				

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-11: BUILDING 2702

TIME 12:28:00

SI DIVISION SUMMARY

SUMMARY PAGE 6

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	344	11,362	44	73,243	3,662	88,312
TOTAL DIRECT	344	11,362	44	73,243	3,662	88,312

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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SYSTEMS SUMMARY

SUMMARY PAGE 7

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	344	11,362	44	73,243	3,662	88,312
TOTAL DIRECT	344	11,362	44	73,243	3,662	88,312

Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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EQUIPMENT SUMMARY

SUMMARY PAGE 8

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
EMI20 SHALL TOOLS								1.40	1.40	32	44
TOTAL PROJECT EQUIPMENT HOURS										32	44



Tue 28 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-11: BUILDING 2702

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LABOR SUMMARY

SUMMARY PAGE 9

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.00	24.00	7.49	0.00	32.91	25.79	344	11,363
TOTAL PROJECT MANHOURS								344	11,363

\*\*\* END OF SUMMARY REPORT \*\*\*

## 6 NAF LIGHTING

---

This section contains the analysis results for the indoor lighting study for Building 6902 classified as non-appropriated funding (NAF). Included in this section are the life cycle cost analysis, energy calculations, and cost estimate for the facility. Please refer to *Section 3* for a detailed description of the ECO.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 6902ECO6

LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT CAMPBELL    REGION NOS.    4    CENSUS: 3

PROJECT NO. & TITLE: 006-6902    INTERIOR LIGHTING / BUILDING 6902

FISCAL YEAR 1994    DISCRETE PORTION NAME: LIGHTING

ANALYSIS DATE: 09-15-93    ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

1. INVESTMENT

A. CONSTRUCTION COST	\$	6686.		
B. SIOH	\$	368.		
C. DESIGN COST	\$	368.		
D. TOTAL COST (1A+1B+1C)	\$	7422.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		7422.	

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 6.18	48.	\$ 297.	11.77	\$ 3491.
B. DIST	\$ .00	0.	\$ 0.	13.83	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	16.15	\$ 0.
D. NAT G	\$ 4.00	0.	\$ 0.	15.34	\$ 0.
E. COAL	\$ .00	0.	\$ 0.	12.82	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 493.	11.12	\$ 5482.
N. TOTAL		48.	\$ 790.		\$ 8974.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 48.
(1) DISCOUNT FACTOR (TABLE A)	11.12	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 534.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPLACE	\$ 5707.	8	.73	4166.
d. TOTAL	\$ 5707.			4166.

LIFE CYCLE COST ANALYSIS SUMMARY  
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
 INSTALLATION & LOCATION: FT CAMPBELL REGION NOS. 4 CENSUS: 3  
 PROJECT NO. & TITLE: 006-6902 INTERIOR LIGHTING / BUILDING 6902  
 FISCAL YEAR 1994 DISCRETE PORTION NAME: LIGHTING  
 ANALYSIS DATE: 09-15-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

STUDY: 6902ECO6  
 LCCID 1.072

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)\$ 4700.  
 4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 1218.  
 5. SIMPLE PAYBACK PERIOD (1G/4) 6.09 YEARS  
 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 13673.  
 7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 1.84  
 (IF < 1 PROJECT DOES NOT QUALIFY)  
 8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.32 %

# FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 6: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

30 SEPTEMBER 1993

PAGE 1 OF 2

## BUILDING WIDE FLUORESCENT FIXTURE REPLACEMENT

BUILDING #: 6902

BUILDING USE:

HOURS/DAY 10

DAYS/WEEK 7

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

### EXISTING FIXTURE DATA

#### 4 FOOT

0.1 LAMP @ 48 W/FIXT = 0 WATTS  
 0.1 LAMP @ 37.8 W/FIXT = 0 WATTS  
 4.2 LAMP @ 96 W/FIXT = 384 WATTS  
 0.2 LAMP @ 75.6 W/FIXT = 0 WATTS  
 0.3 LAMP @ 144 W/FIXT = 0 WATTS  
 0.3 LAMP @ 113.4 W/FIXT = 0 WATTS  
 26.4 LAMP @ 192 W/FIXT = 4992 WATTS  
 0.4 LAMP @ 151.2 W/FIXT = 0 WATTS

#### 2 FOOT

0.1 LAMP @ 31 W/FIXT = 0 WATTS  
 0.4 LAMP @ 88 W/FIXT = 0 WATTS  
 0.2 LAMP U @ 96 W/FIXT = 0 WATTS  
 0.2 LAMP U @ 75.6 W/FIXT = 0 WATTS

#### 8 FOOT

0.2 LAMP @ 180 W/FIXT = 0 WATTS  
 0.2 LAMP @ 168 W/FIXT = 0 WATTS

TOTAL EXISTING KW 5.38

BASELINE ENERGY CONSUMPTION 66.76 MBTU

### REPLACEMENT FIXTURE DATA

#### 4 FOOT

0.1 LAMP @ 37 W/FIXT = 0 WATTS  
 4.1 LAMP W/ REFLECTORS 37 W/FIXT = 148 WATTS  
 0.2 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS  
 26.2 LAMP W/ REFLECTORS 58 W/FIXT = 1508 WATTS

#### 2 FOOT

0.1 LAMP @ 24 W/FIXT = 0 WATTS  
 0.2 LAMP W/ REFLECTORS 41 W/FIXT = 0 WATTS  
 0.2 LAMP U @ 58 W/FIXT = 0 WATTS

#### 8 FOOT

0.1 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS

TOTAL REPLACEMENT KW 1.66

REPLACEMENT ENERGY CONSUMPTION 20.57 MBTU

NET ENERGY SAVINGS 46.20 MBTU/YR

NET DOLLAR SAVINGS \$812.11

# FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 6: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

30 SEPTEMBER 1993

PAGE 2 OF 2

## BUILDING WIDE INCANDESCENT LAMP REPLACEMENT

BUILDING #: 6902

### LAMP USE:

HOURS/DAY 10

DAYS/WEEK 7

PEAK USE 1 (1-YES, 2-NO)

### ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

### EXISTING INCANDESCENTS

0 LAMPS @	25 WATTS =	0 WATTS
0 LAMPS @	40 WATTS =	0 WATTS
3 LAMPS @	52 WATTS =	156 WATTS
0 LAMPS @	60 WATTS =	0 WATTS
0 LAMPS @	75 WATTS =	0 WATTS
0 LAMPS @	90 WATTS =	0 WATTS
0 LAMPS @	100 WATTS =	0 WATTS

TOTAL EXISTING WATTS 156

BASELINE ENERGY CONSUMPTION 1.94 MBTU

### COMPACT FLUORESCENT REPLACEMENT

0 LAMPS @	7 WATTS =	0 WATTS
0 LAMPS @	9 WATTS =	0 WATTS
3 LAMPS @	13 WATTS =	39 WATTS
0 LAMPS @	18 WATTS =	0 WATTS
0 LAMPS @	26 WATTS =	0 WATTS

TOTAL REPLACEMENT WATTS 39

REPLACEMENT ENERGY CONSUMPTION 0.43 MBTU

NET ENERGY SAVINGS 1.45 MBTU/YR

NET DOLLAR SAVINGS \$25.54

Thu 09 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 15:48:52

TITLE PAGE

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ENERGY SAVINGS OPPORTUNITY SURVY  
FT CAMPBELL, KY  
ECO-6: BUILDING 6902

Contract No: 27-93-C-0096

Prepared By: Systems Corp  
Estimator: Keith A. Derrington  
Estimate Prep. Date: 09/30/93  
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N  
COMPOSER Plus Copyright (C) 1985, 1988  
by Building Systems Design, Inc.  
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

Thu 09 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-6: BUILDING 6902

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DETAILED ESTIMATE	DETAIL PAGE
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AA. ELECTRICAL.....	1

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U.S. ARMY CORPS of ENGINEERS M-CACES  
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
 ECO-6: BUILDING 6902  
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

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DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING									
16512 6100 SMALL FL FIXTURES (LESS THAN 40 WATT LAMPS)									
CD=3 EL 6105 SURF SQ W/1 13W BIAXIAL FL LAMP *** UNIT COSTS: ***				1.25	41.26	0.00	27.80	1.39	70.45
WC=1100 WHITE ACRYLIC LENS	3.00	EA	EELEA	4	124	0	83	4	211
16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST									
CD=3 EL 7002 4 FT 1 LAMP PARABOLIC LOUVRE W/ *** UNIT COSTS: ***				0.54	17.84	0.07	122.00	6.10	146.01
WC=1100 REFLECTOR	4.00	EA	EELEB	2	71	0	488	24	584
CD=3 EL 7003 4 FT 2 LAMP PARABOLIC LOUVRE W/ *** UNIT COSTS: ***				0.59	19.42	0.08	136.00	6.80	162.29
WC=1100 REFLECTOR	26.00	EA	EELEB	15	505	2	3,536	177	4,220
TOTAL DIVISION 16 ELECTRICAL	21			700		2	4,107	205	5,015
TOTAL FACILITY AA. ELECTRICAL	21			700		2	4,107	205	5,015
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE	21			700		2	4,107	205	5,015
TOTAL BASE BID	21			700		2	4,107	205	5,015
TOTAL ADDITIVE	0			0		0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY	21			700		2	4,107	205	5,015

\* \* \* END OF DETAIL REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

Thu 09 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
ECO-6: BUILDING 6902

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PROJECT NOTES

SUMMARY PAGE 1

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PROJECT NOTES

ECO-6: INTERIOR LIGHTING

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY INTERIOR LIGHTING IN  
SELECTED FACILITIES AT FT CAMPBELL.

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

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U.S. ARMY CORPS of ENGINEERS M-CACES  
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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	5,015	502	0	414	148	0	6,079	6078.54
BID ITEM TOTAL		1.00 EA	5,015	502	0	414	148	0	6,079	6078.54
TOTAL BASE BID			5,015	502	0	414	148	0	6,079	
TOTAL ADDITIVE			0	0	0	0	0	0	0	
TOTAL INCL ADD			5,015	502	0	414	148	0	6,079	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

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PROJECT CWE SUMMARY

SUMMARY PAGE 3

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	6,079		6,079	6078.50
TOTAL CURRENT CONTRACT COST				6,079	0	6,079	
Cost Growth from 09/93 to 09/94 Index Values: 0000 0000		0.0%		0	0	0	
ESCALATED CONTRACT COST				6,079	0	6,079	
Government-Furnished Property				0		0	
SUBTOTAL				6,079	0	6,079	
Contingencies		10.0%		608	0	608	
SUBTOTAL				6,686	0	6,686	
SIOH (S&A)		5.5%		368	0	368	
CURRENT WORKING ESTIMATE				7,054	0	7,054	

Estimated Construction Time 365 Days

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

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U.S. ARMY CORPS of ENGINEERS M-CACES  
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CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 4

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	21	700	2	4,313		5,015 100.0%	0	5,015
	TOTAL DIRECT				21	700	2	4,313		5,015 100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

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U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		5,015	502	10.0%	0.0	414	7.5%	2.5%	0.0%	6,079	100.0%	6078.54
	TOTAL OVERHEAD & PROFIT			502	10.0%		414	7.5%					

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

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U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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CSI DIVISION SUMMARY

SUMMARY PAGE 6

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	21	700	2	4,107	205	5,015
TOTAL DIRECT	21	700	2	4,107	205	5,015

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

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U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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SYSTEMS SUMMARY

SUMMARY PAGE 7

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	21	700	2	4,107	205	5,015
TOTAL DIRECT	21	700	2	4,107	205	5,015

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6



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U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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EQUIPMENT SUMMARY

SUMMARY PAGE 8

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
EMI20 SMALL TOOLS								1.40	1.40	2	2
TOTAL PROJECT EQUIPMENT HOURS										2	2

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

Thu 09 Sep 1993

U.S. ARMY CORPS of ENGINEERS M-CACES  
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY  
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LABOR SUMMARY

SUMMARY PAGE 9

CRAFT DESCRIPTION	BASE	OVERTH	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	21	700
TOTAL PROJECT MANHOURS								21	700

\* \* \* END OF SUMMARY REPORT \* \* \*

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6902E6

6-17

LOUISVILLE DISTRICT CORPS OF ENGINEERS  
ENGINEERING DIVISION, A/E MANAGEMENT BRANCH (CEORL-ED-M)

ANNEX B

DETAILED SCOPE OF WORK

Phase I Basic Contract, & Option Phase II Added ECOs, FORT CAMPBELL, KY  
May 10, 1993

1. PROJECT NAME & LOCATION: This is an Energy Savings Opportunity Survey (ESOS), FY93 EEAP at Fort Campbell, KY for various ECOs (Energy Conservation Opportunities) selected in ANNEX A. The Basic Contract award will be for Phase I ECOs prioritized 1 through 5, as selected from ANNEX A, with an Option for Phase II Additional ECOs prioritized 6 through 10 as selected from ANNEX A, and the buildings to be included are listed in Figure B-1.1. The ECOs are summarized as follows:

Phase I- Basic Contract:

1. Instantaneous hot water heater.  
77 systems in administrative type facilities-conversion
2. Ground water coupled heat pump.  
6 individual family quarters out of 770ea. sampling.
3. Heat reclaim from hot refrigerant gas/condenser units.  
1 facility- Commissary for hot gas reclamation.
4. Replace absorption chiller with high efficiency units.  
15 chillers- replacements.
5. Indoor/outdoor lighting efficiency to recommended levels.  
43 administrative type fac. for indoor/outdoor lighting efficiency. Same fac.'s to be surveyed as in 1. above.  
5 family housing areas for street lights.

Phase II- Option, Added ECOs:

6. Reduce indoor, outdoor, or street lighting where illumination exceeds AEI recommended levels.  
37 administrative type fac. for indoor/outdoor lighting efficiency. Same fac.'s to be surveyed as in 1. above.  
4 family housing areas for street lights.
7. Waste heat recovery-Heat exchanges for ventilation and hot water heat.  
15 building locations. Same buildings surveyed as in 1. above.
8. Chiller replacements.  
7 chillers in 5 buildings.
9. Variable speed circulation pumps.  
57 pumps in barracks (Korean War built).
10. EMCS expansion of buildings and functions.  
17 buildings add onto the existing system.

2. GENERAL SOW vs. DETAILED SOW: The General Scope of Work (GSOW) will apply to contract efforts as modified by the Detailed Scope of Work (DSOW). Should conflicts occur between the GSOW and DSOW, the DSOW shall govern.

3. RESPECTIVE POC's for this STUDY:

Louisville District COE- Charles (Chuck) Lockman/CEORL-ED-M  
(502) 582-6041, or FAX 6763, or 5281

Fort Campbell, KY DEH- Arlin E. Wright/Supv. Industrial Engr.  
DEH-MESB (502) 798-8895, or FAX 9596

Architect/Engineer(A/E)- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. SCOPE:

4.1 The A/E shall provide all work necessary to complete the ESOS as defined in the GSOW including the ANNEX's. Information and instructions contained within the Detailed SOW are provided as a means for the A/E Project Manager (P/M) to expand or modify the GSOW as may be needed to suit the survey for the ESOS ECOs at Fort Campbell, KY.

4.2 The survey will consider all components and aspects of operations of a selection of facilities, replacements, materials, utilities, envelopes, boilers, alternatives methods of equipment, and etc. to determine any energy savings methods/recommendations, energy savings operational methods, systems energy savings requirements, and all operations that could realize energy savings. This could include interviews of various personnel at the installation to accomplish data gathered for quantities, and operational data. Alternate energy sources such as solar, wind, and geothermal, will not be included.

4.3 The survey will consider new designs etc., for energy trends that make each ECO more cost effective and energy saving.

4.4 The A/E shall assist the DEH in arranging for the installation of any metering of various utilities identified in the ECO, such as for electric, gas, etc.

5. DETAILED REQUIREMENTS: All detail requirements selected at Fort Campbell, KY for the purpose of this survey, shall specifically include the special facility and projects identified by the DEH staff. In general the facilities and projects, when investigated relative to the ECO's provided in ANNEX A, shall comprise the bulk of suggestive items normally investigated for the ESOS.

Specific Energy Conservation Opportunities (ECO) Checklist: Each ECO selected from the list in ANNEX A shall be investigated as a minimum, however, if others are found during the investigation that are good candidates they shall also be included and evaluated.

6. PERFORMANCE: The total time required for completion of the ESOS initial award of Phase I shall not be more than 211 calendar days from the date of the Notice to Proceed (NTP) for the contract. Phase II Option award may occur simultaneously with the Phase I award, then the schedule would be required as

printed/scheduled in Figure B-6.1, however, award of Phase II may not occur, and may be scheduled separately on a 175 calendar day basis for completion criteria, from the NTP award. If the ESOs, either Phase I and/or Phase II Option takes the A/E less time than scheduled to achieve, an interim interview meeting at the installation may be coordinated by the A/E with all parties involved in the review process. Figure B-6.1 is a schedule of pertinent events and milestone dates for acceptable performance of the survey at Fort Campbell, KY. Changes or adjustments made to the SOW during the term of the project survey shall be made by the Louisville District.

7. SUBMITTALS: The A/E's Project Manager shall provide direct distribution of all required submittals and documents in the numbers as listed in Figure B-7.1.

8. GOVERNMENT-FURNISHED INFORMATION: The following list of reference documents will be furnished to the A/E:

(1) Final reports of previously completed studies performed under the Energy Engineering Analysis Program (EEAP), See par. 10 for the list.

(2) Latest copies of other energy studies performed since the previous EEAP study, see par. 10 for the list.

(3) Energy Resources Management Plan.

(4) ETLs 1110-3-254, Use of Electric Power for Comfort Space Heating, 1110-3-282, Energy Conservation, 1110-3-318, Procedures for Programming Energy Monitoring and Control Systems (EMCS) Funded through the MCA Program and 1110-3-332, Economic Studies.

(5) Architectural and Engineering Instructions.

(6) Energy Conservation Investment Program (ECIP) Guidance, dated 4 November 1992.

(7) Information on Existing EMCS Studies, Designs, Construction Contracts, or Operating Systems. (Only if needed for this survey)

(8) TM 5-785, Engineering Weather Data, TM 5-800-2, General Criteria Preparation of Cost Estimates, TM 5-800-3, Project Development Brochure, TM 5-815-2, Energy Monitoring and Control Systems (EMCS). TM 5-815-2 need only be furnished if items (7), (10), and (11) are furnished.

(9) AR 415-15, Military Construction Army (MCA) Program Development; AR 415-17, Cost Estimating for Military Programming; AR 415-20, Construction, Project Development and Design Approval; AR 415-28, Department of the Army Facility Classes and Construction Categories; AR 415-35, Construction, Minor Construction; AR 420-10, General Provisions, Organization, Functions, and Personnel; AR 11-27, Army Energy Program; and AR 5-4, Change No. 1, Department of the Army Productivity Improvement Program.

(10) HNDSP-84-076-ED-ME, Preliminary Survey and Feasibility Study for Energy Monitoring and Control Systems. (Only if needed for this study).

(11) CEHND-SP-90-244-ED-ME, EMCS Cost Estimating Guide. (Only if needed for this study).

(12) NCEL CR 82.030, Standardized EMCS Energy Savings Calculations. (Only if needed for this study).

(13) The latest applicable Engineer Improvement Recommendation System (EIRS) bulletin.

(14) An example of a correctly completed implementation document for a project.

8. LCCID, A COMPUTER PROGRAM: A computer program titled Life Cycle Costing in Design (LCCID) is available from the BLAST Support Office in Urbana, IL for a nominal fee. This computer program will be used for performing the economic calculations for ECIP and non-ECIP ECO's. LCCID permits the designer to perform an economic study that conforms to the economic criteria all three services. POC is Linda Lawrie. The A/E is encourage to obtain and use this computer program, because is a universal Government comparison tool that requires comparisons throughout the US for such type surveys and data requirements. The A/E will obtain and use this computer program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, IL 61801. The telephone number is (217) 333-3977 or (800) 842-5278. All economic analysis can be performed using simple payback period, however, LCCA will be required for the Government information.

9. SIMULATION PROGRAMS: No computer simulation will be required under this project.

10. LIST OF EEAP REPORTS/STUDIES, FORT CAMPBELL: A review of the following is considered to be of assistance for in the DSOW. The COE and DEH Offices have a copy for review, and/or loan:

- a. Basewide Energy System Plan, Executive Summary, 03/01/83
- b. Basewide Energy System Plan, Vol. 1, & 2, 12/01/82
- c. Energy Consumption & Requirement Survey, 12/01/77
- d. Energy Audit, Dining Facilities, Exec. Summary, 08/01/86
- e. Energy Audit, Dining Facilities, Vol. 1-5, 08/01/86
- f. Limited Energy Study, Cold Stg. Fac., 01/18/93
- g. Energy Efficient Motors, by COE, list of, 11/04/92, sch.comp.5/93

FIGURE E-1.1 Listing of Buildings/Facilities/or Areas to be studied in the  
ECOs, FORT CAMPBELL, KY:

BASIC CONTRACT, PHASE I:

1. Instantaneous Hot Water Heater- 77 Administrative type fac's:

38	6087	6734	6914
89	6088	6735	6915
91	6137	6736	6916
93	6140	6737	6924
95	6254	6738	6924A
2699	6302	6740	6925
2745	6304	6744	6926
3202	6306	6773	6932
3209	6308	6784	6934
3210	6390	6789	6935
3307	6706	6790	6991
3308	6708	9001	6993
3411	6713	6902	6995
4601	6714	6904	6997
5207	6715	6905	7510
5210	6717	6906	7541
5212	6720	6907	7838
5661	6723	6908	7855
5702	6729	6913	7856
5740			

2. Ground Water Coupled Heat Pump- 6 individual family type quarters:

There are 770 family quarters that currently have heat pumps that need upgrading due to age and limited design characteristics that show up during extreme cold weather conditions. Currently 630 units of same type are being converted to gas package type heating/cooling units. This is a sample study of the 770 units for possible applications as a cross section of various types structures. The locations of areas follows:

<u>Location</u>	<u>Type/Size</u>	<u>Number of Quarters</u>
La Pointe Village (downstairs)	2 bedroom	2-6 Units
La Pointe Village (upstairs)	2 bedroom	2-6 Units
Hammond Heights	4 bedroom	2-4 Units
Drennon Park	4 bedroom	1-2 Units
Drennon Park	4 bedroom	Single Unit

3. Heat Reclaim from Hot Refrigerant Gas/Condenser Units:

1 Facility- Commissary, building 2702

CONTINUED-PHASE I:

4. Replace Absorption Chiller with High Efficiency Units- 15 chillers, size 90-570 tons:

<u>Building Location</u>	<u>Chiller Size</u>
3213	140
3214	250
6711	360
6718	140
6726	360
6732	300
6774	90
6776	320
6781	320
6910	320
6921A	570
6929	320
6936	160
6938	320
6944	380

5. Indoor/Outdoor Lighting Efficiencies to Recommended Levels-

a. 43 Administrative Type Facilities for Indoor Survey

(same facilities to be surveyed as in 1. above):

<u>Location</u>	<u>sq. ft.</u>	<u>Location</u>	<u>sq. ft.</u>
38	16,038	6140	3,867
89	11,545	6254	9,338
91	12,873	6302	5,615
93	17,492	6304	5,385
95	21,864	6306	5,615
2699	3,319	6308	5,385
2745	13,249	6390	12,792
3202	13,381	6708	2,581
3204	2,250	6713	3,610
3206	3,746	6714	2,686
3209	3,598	6715	18,902
3307	2,816	6717	2,581
3308	2,252	6720	4,892
3411	20,918	6723	3,610
5207	169,375	6729	3,610
5212	2,160	7510	14,280
5661	22,480	7514	4,064
5702	14,000	7541	8,904
5740	14,173	7543	998
6087	10,768	7562	1,800
6088	4,988	7574	325
6137	1,440		

b. 5 Family Quarters Areas for Street Lighting Survey:

Hammond Heights  
Lee Village  
Pierce Village  
LaPointe Village  
Gardner Village



OPTION, PHASE II:

6. Reduce Indoor, Outdoor, or Street Lighting to Recommended Levels:

- a. 37 Administrative Type Facilities for Indoor Survey:  
(same facilities to be surveyed as in 1. above)

<u>Location</u>	<u>sq. ft.</u>	<u>Location</u>	<u>sq. ft.</u>
6734	3,610	6913	2,581
6735	2,746	6914	3,610
6736	2,581	6915	3,610
6737	2,581	6916	2,581
6738	2,581	6924	2,581
6740	4,141	6924A	3,688
6744	7,200	6925	3,610
6773	2,581	6926	2,581
6784	2,581	6932	1,000
6789	3,610	6933	3,610
6790	3,610	6934	3,610
6901	9,303	6935	2,581
6902	3,867	6991	3,688
6903	2,686	6993	3,688
6904	2,581	6995	3,688
6905	2,581	6997	3,568
6906	2,581	7855	10,815
6907	2,581	7856	9,607
6908	2,581		

- b. 5 Family Quarters Areas for Street Lighting Survey:

Cole Park	Gardner Hills
Drennan Park	Werner Park
Stryker Village	

7. Waste Heat Recovery-Heat Exchanges for Ventilation and Hot Water Heat-  
15 locations: (Same buildings surveyed in 4. above)

Boilers are in each of these facilities that provide heat in the winter months, also heat for absorption type chiller units in summer months. Excess heat possibly could be recycled by heat exchangers to help make needed hot water as well as heat for ventilation within each boiler facility.

Building location with Boilers

3213	3214	6711	6718
6726	6732	6774	6776
6781	6910	6921A	6929
6936	6938	6944	

8. Chiller Replacements-7 Chillers at 5 Building Locations:

<u>Building Location</u>	<u>Chiller Type/MFG</u>
38	2 units, Carlyne, Carrier
93	2 units, Trane Model #2E5E58NUR2 #2E5F58N

(continued 8., next page)

CONTINUED-PHASE II:

95

1 unit, Worthington Model  
#3VHP6

98

2 units, Trans Model  
#2E5RG8  
#CCUA7506EA

9. Variable Speed Circulation Pumps: Each Korean War Barracks has a circulation pump for heating/cooling water supplied to the fan coil units. There are 49 facilities/pumps in the 6700-6900 block plus an additional 8 facilities in the 3200 block. An ESOS is needed to determine the energy savings by application of variable speed- electronic controls on the pump motors.

10. EMCS Expansion of Buildings and Functions- Adding 17 buildings:

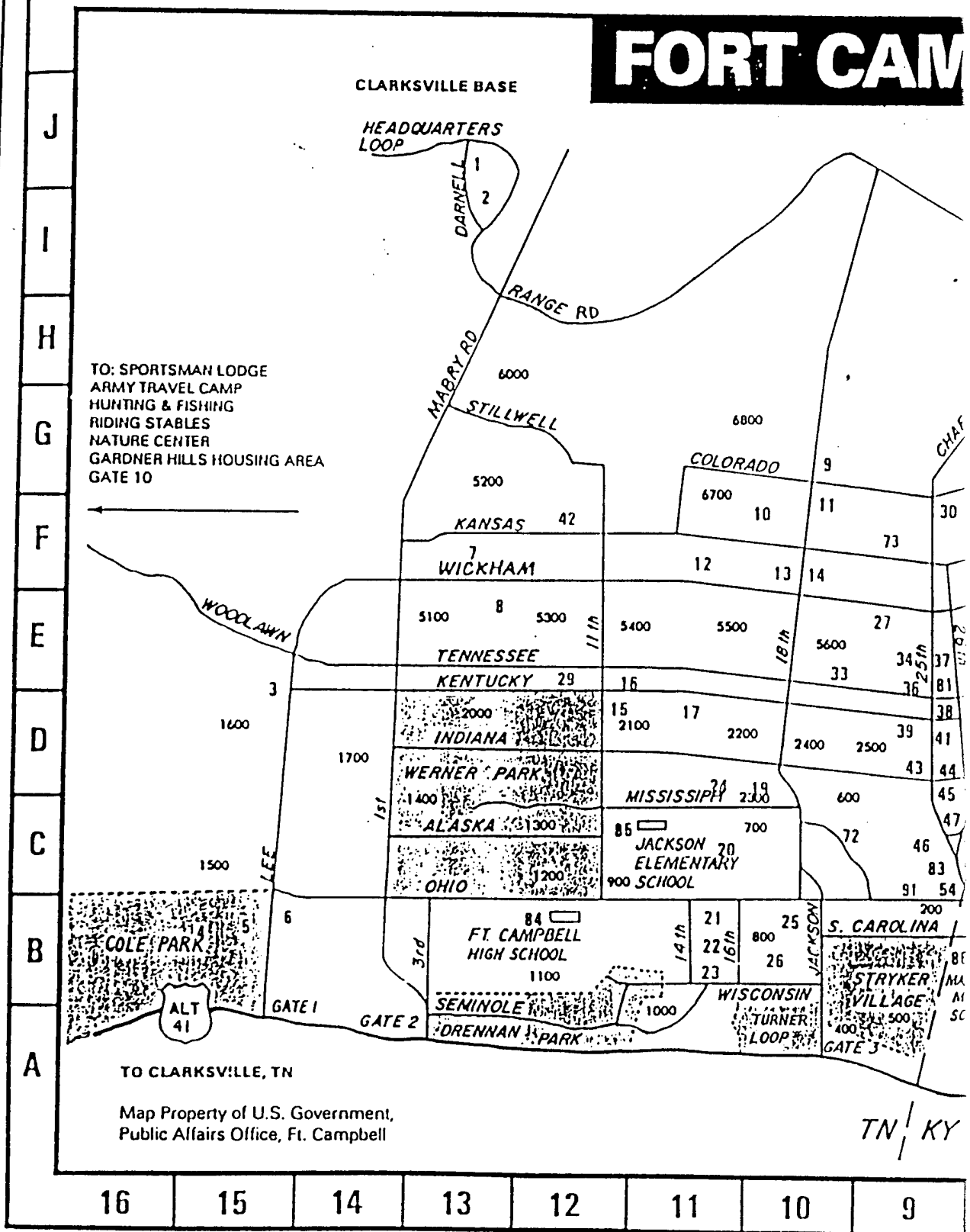
Building Location

80  
307  
2702  
2840  
3069  
3071  
3934  
5004  
5380

Building Location

6627  
6628  
6636  
6637  
7262  
7267  
7268  
7272

# FORT CAMP



# LEGEND

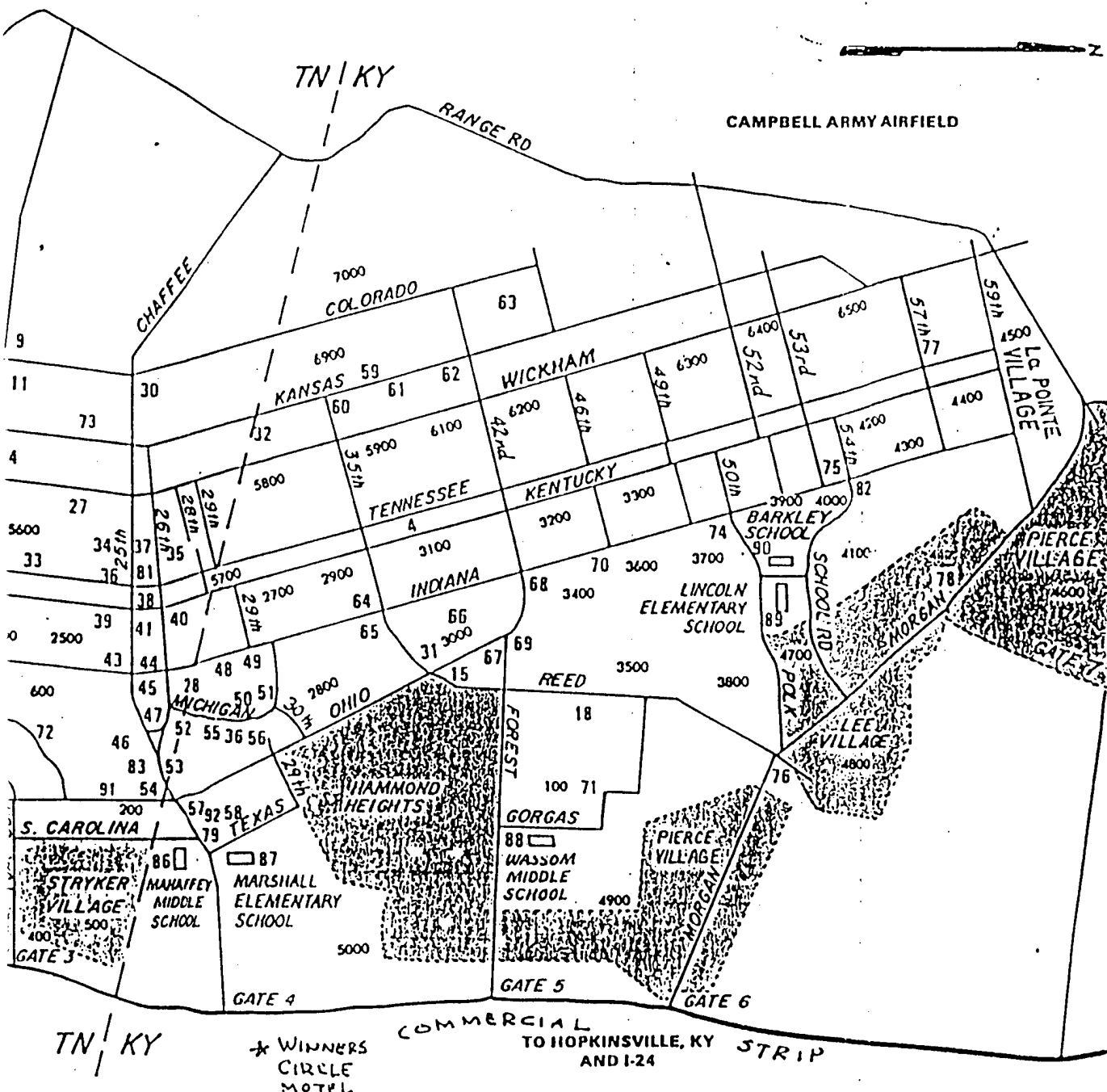
ACS Welcome Center (44)  
Air Assault Landing Pad (9)  
Air Assault School (11)  
Army Community Services Center (58)

Auto Craft Shop (14)  
Bachelor Enlisted Quarters (65)  
Bachelor Officers Quarters (4)  
G-10 Baldonado Swimming Pool (43)  
G-10 Bank (51)  
B-8 Barkley School (90)

F-10  
D-7  
E-6 & B-15  
D-9  
D-8  
E-3

Burger King (37)  
Champions Sports  
Chapels and Chap  
Chaplain Acti  
Chaplain Acti  
Hospital Chap  
Community C  
Eagle Chapel  
Faith Chapel  
Fellowship Ch  
Grace Chapel  
Peace Chapel  
Hope Chapel  
Memorial Chu  
Soldiers Chap  
Civilian Personnel  
Clarksville Base  
Clarksville Base  
Cole Park Golf Co  
Commissary (49)  
Community Life C  
Consolidated Sup  
Credit Union (28)  
Directorate of Info  
Division and Post  
Division Resource  
Dryer Field House  
Eagle Conference  
Eagles Roost Recre  
Estep Physical Fitn  
Facilities Engineer  
Finance and Accou  
Fort Campbell Hig  
Four Seasons/Toy  
Fratellenico Physic  
Fryar Stadium (33)  
Gardner Bowling  
Gardner Swimm  
Certsch Physical F  
Greyhound Bus St  
Guenette Arts & C  
Hooper Bowling C  
Hospital - Colonel  
Army Commu  
In-Out Processing  
Inspector General  
Jackson Elementar  
Kentucky Fried Ch  
Kuhn Dental Clinic  
Lee Recreation Cen  
Lee Village Exchan  
Library (46)  
Lincoln Elementar  
Lozada Physical Fi  
Mahaffey Middle S  
Main Post Exchang  
Marshall Elementa  
Muldoon Swimm  
NCO/Eagle Rende  
Noncommissioned  
Officers Open Mes  
Officers Swimm  
Olive Physical Fitn  
Package Store (26)  
Patio Laundromat  
Perez Baseball Fie  
Post Office (55)  
Pratt Museum/Wk  
Provost Marshall's  
Public Affairs Offic  
Purchasing and Co  
PX Service Station  
Recycling Center (4  
Red Cross Office (8  
Shoppette (15)  
Simms Guest Hous  
Single Swimming P  
Small Animal Clinic  
Synthetic Trainer C  
Taylor Dental Clinic  
Thrift Shop (22)  
Transportation Divi  
Vehicle/Weapons R  
Wassom Middle Sch  
Waynyren Recreati  
Wilson Theater (52)  
WINNERS CIRCLE

# CAMPBELL, KY



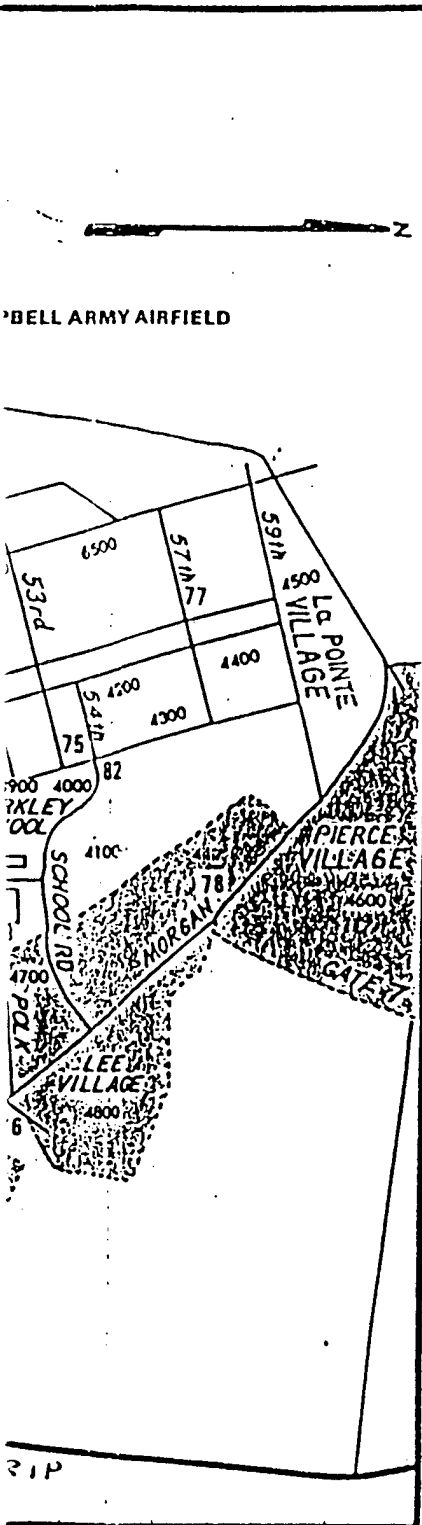
9	8	7	6	5	4	3	2	1
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# FORT CAMPBELL, KY

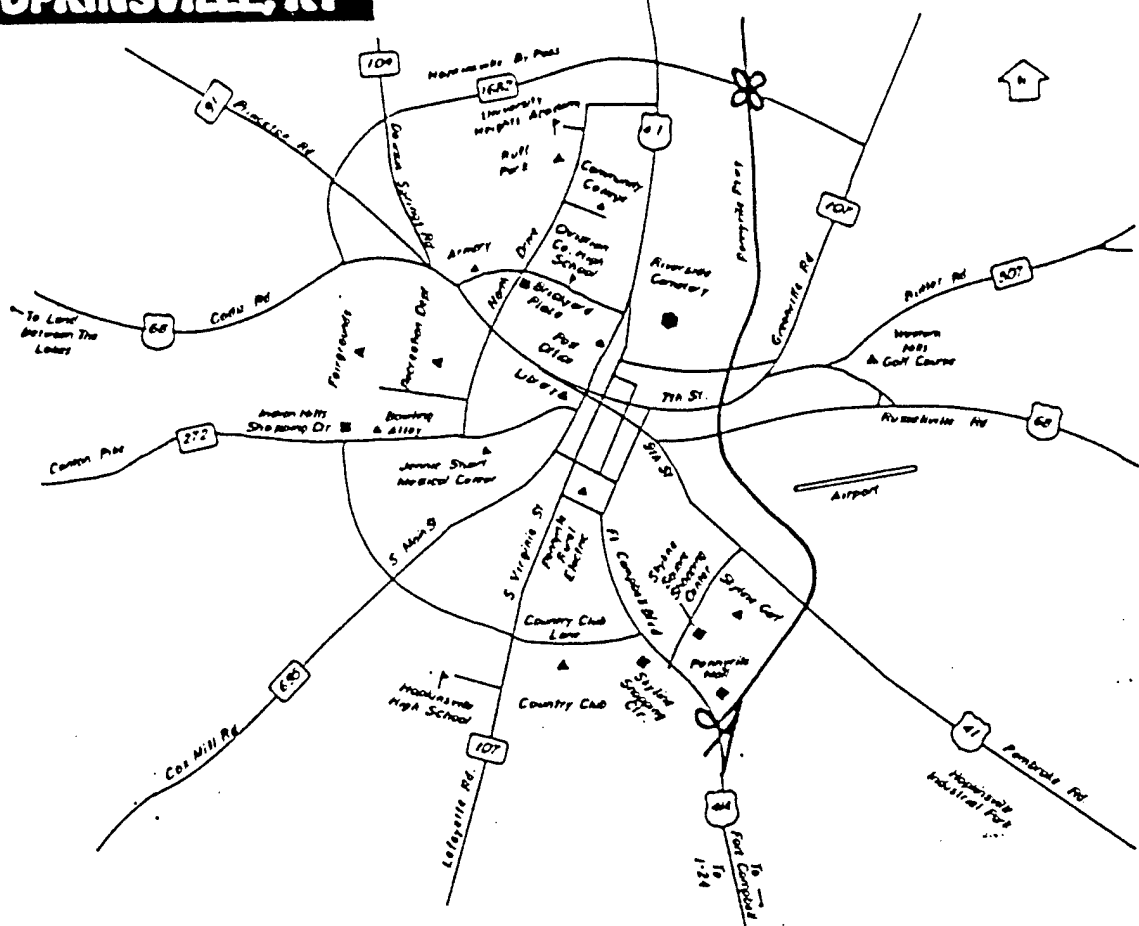
Auto Craft Shop (14) F-10  
 Bachelor Enlisted Quarters (65) D-7  
 Bachelor Officers Quarters (4) E-6 & B-15  
 Baldonado Swimming Pool (43) D-9  
 Bank (51) D-8  
 Barkley School (90) E-3

Burger King (37) E-1  
 Champions Sports Club (82) F-1  
 Chapels and Chaplain Offices  
     Chaplain Activities Office (66) D-1  
     Chaplain Activity Center (71) C-1  
     Hospital Chaplain's Office (72) C-1  
     Community Chapel (10) F-1  
     Eagle Chapel (64) D-1  
     Faith Chapel (63) G-1  
     Fellowship Chapel (67) D-1  
     Grace Chapel (70) L-1  
     Peace Chapel (19) D-10  
     Hope Chapel (2) F-1  
     Memorial Chapel (75) F-1  
     Soldiers Chapel (32) F-1  
 Civilian Personnel Office (57) C-1  
 Clarksville Base Physical Fitness Center (2) J-1  
 Clarksville Base Swimming Pool (1) J-1  
 Cole Park Golf Course (3) E-1  
 Commissary (49) D-1  
 Community Life Center (76) C-1  
 Consolidated Supply (7) F-1  
 Credit Union (28) D-1  
 Directorate of Information Management (56) C-1  
 Division and Post Headquarters (47) C-1  
 Division Resources Management Office (91) B-1  
 Dryer Field House (41) D-1  
 Eagle Conference Room (48) D-1  
 Eagles Roost Recreation Center (68) F-1  
 Estep Physical Fitness Facility (17) D-1  
 Facilities Engineers Office (21) B-1  
 Finance and Accounting Office (40) D-1  
 Fort Campbell High School (84) B-1  
 Four Seasons/Toyland (23) B-1  
 Fratellenico Physical Fitness Center (75) F-1  
 Fryar Stadium (33) E-1  
 Gardner Bowling Lanes (69) D-1  
 Gardner Swimming Pool (16) E-1  
 Gertsch Physical Fitness Center (74) E-1  
 Greyhound Bus Station (38) D-1  
 Guenette Arts & Crafts Center (53) C-1  
 Hooper Bowling Center (29) E-1  
 Hospital - Colonel Florence A. Blanchfield  
     Army Community Hospital (72) C-1  
 In-Out Processing Facility (44) D-1  
 Inspector General (92) F-1  
 Jackson Elementary School (85) C-1  
 Kentucky Fried Chicken (31) D-1  
 Kuhn Dental Clinic (60) F-1  
 Lee Recreation Center (34) F-1  
 Lee Village Exchange and Commissary (78) E-1  
 Library (46) C-1  
 Lincoln Elementary School (89) D-1  
 Lozada Physical Fitness Center (59) G-1  
 Mahaffey Middle School (86) B-1  
 Main Post Exchange (50) D-1  
 Marshall Elementary School (87) B-1  
 Muldoon Swimming Pool (12) F-1  
 NCO/Eagle Rendezvous Club (39) D-1  
 Noncommissioned Officers Academy (18) C-1  
 Officers Open Mess (6) B-1  
 Officers Swimming Pool (5) B-1  
 Olive Physical Fitness Center (30) F-1  
 Package Store (26) B-1  
 Patio Laundromat (81) F-1  
 Perez Baseball Field (27) F-1  
 Post Office (55) C-1  
 Pratt Museum/Wickam Hall (35) E-1  
 Provost Marshall's Office (54) C-1  
 Public Affairs Office (79) B-1  
 Purchasing and Contracting Office (24) D-1  
 PX Service Station (24) C-1, F-1  
 Recycling Center (42) F-1  
 Red Cross Office (83) C-1  
 Shoppette (15) D-12, D-1  
 Simons Guest House (45) D-1  
 Single Swimming Pool (62) G-1  
 Small Animal Clinic (20) C-1  
 Synthetic Trainer Complex (77) G-1  
 Taylor Dental Clinic (13) F-1  
 Thrift Shop (22) B-1  
 Transportation Division (25) B-1  
 Vehicle/Weapons Registration (8) E-1  
 Wassom Middle School (88) B-1  
 Wayrynen Recreation Center (61) F-1  
 Wilson Theater (52) C-1

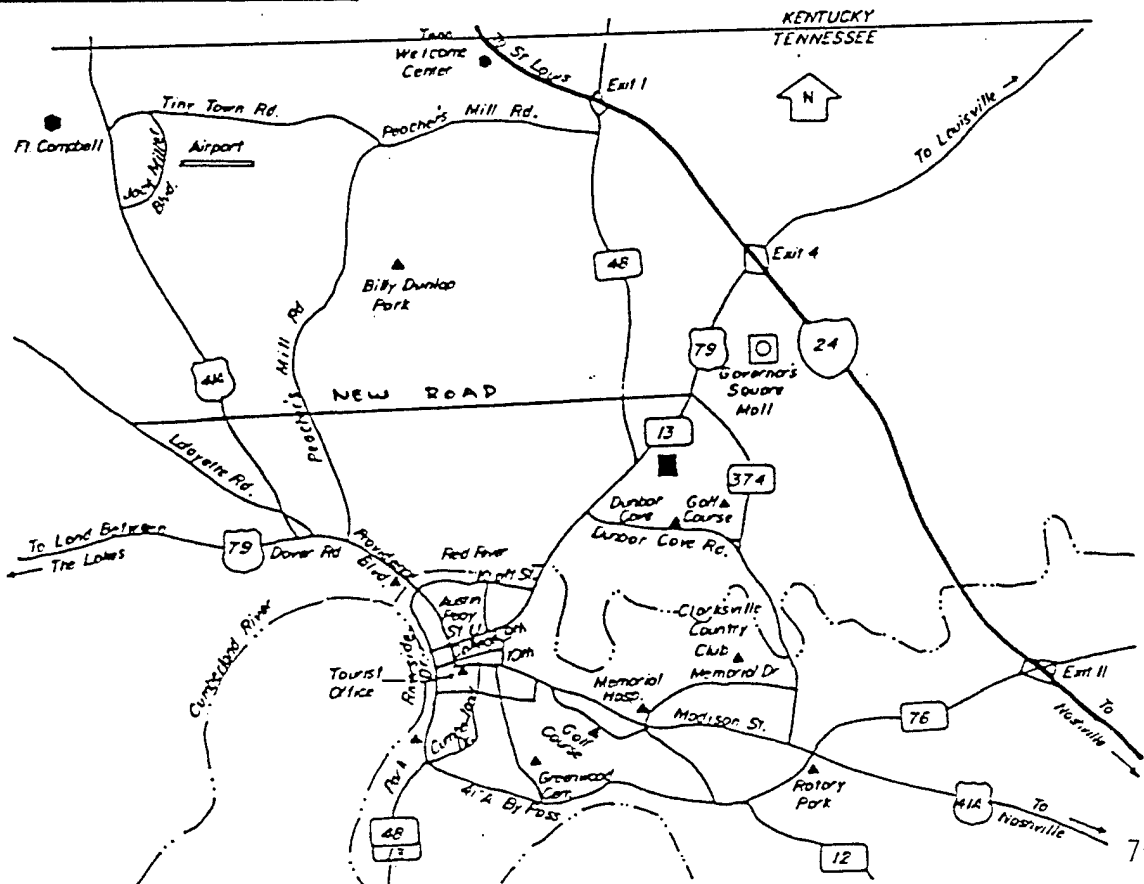
WHITES CIRCLE HOTEL (615) 421-4966



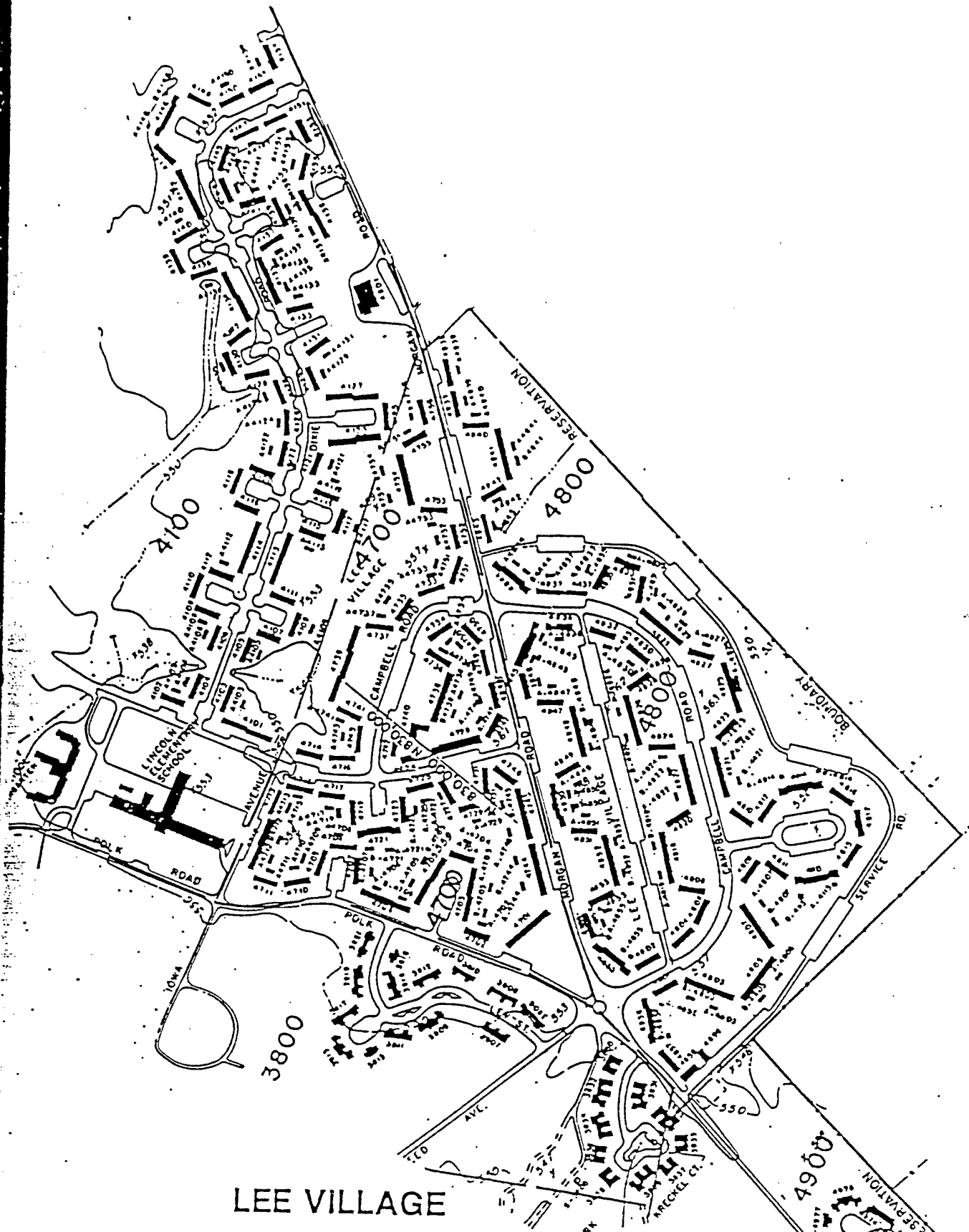
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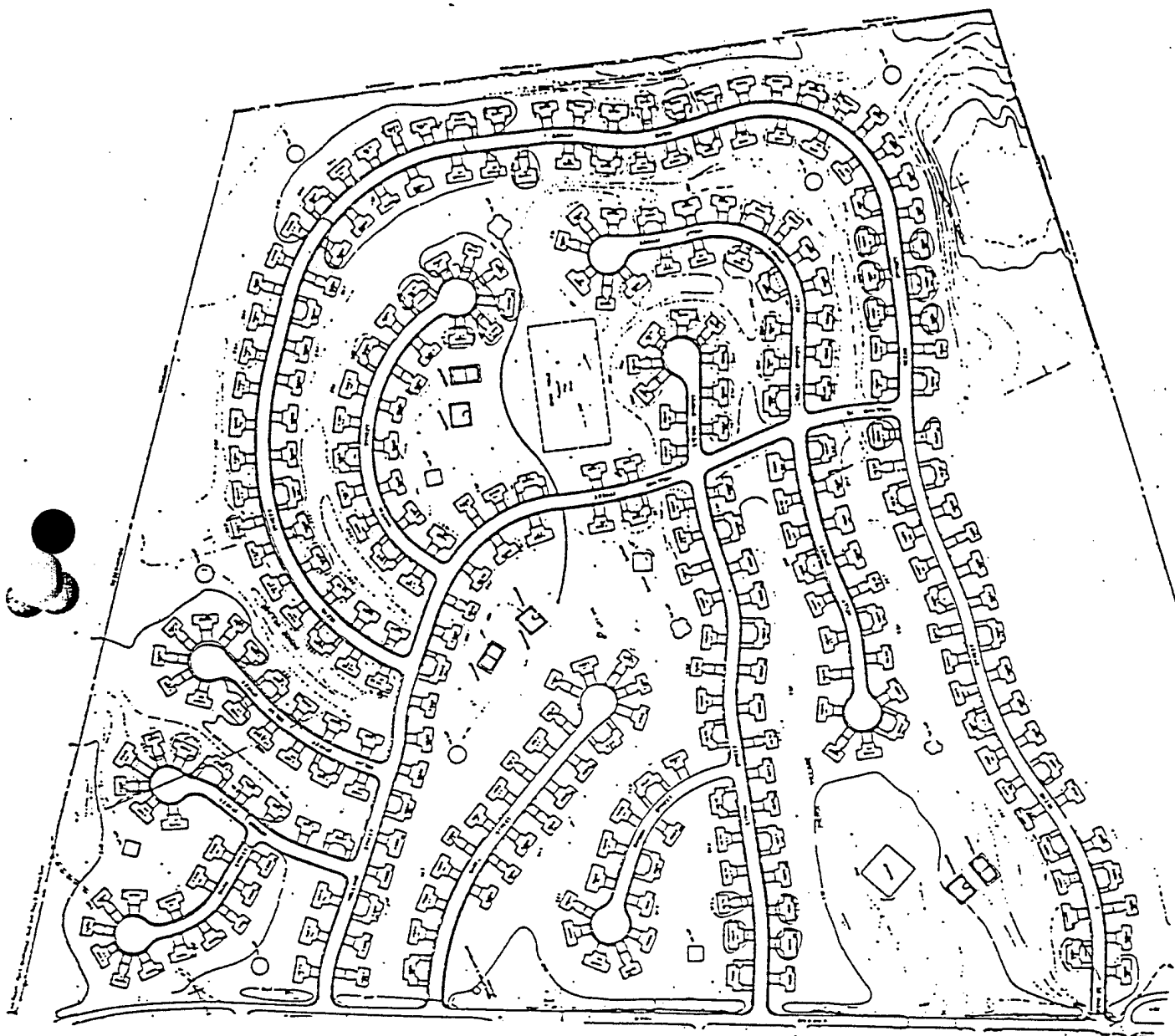
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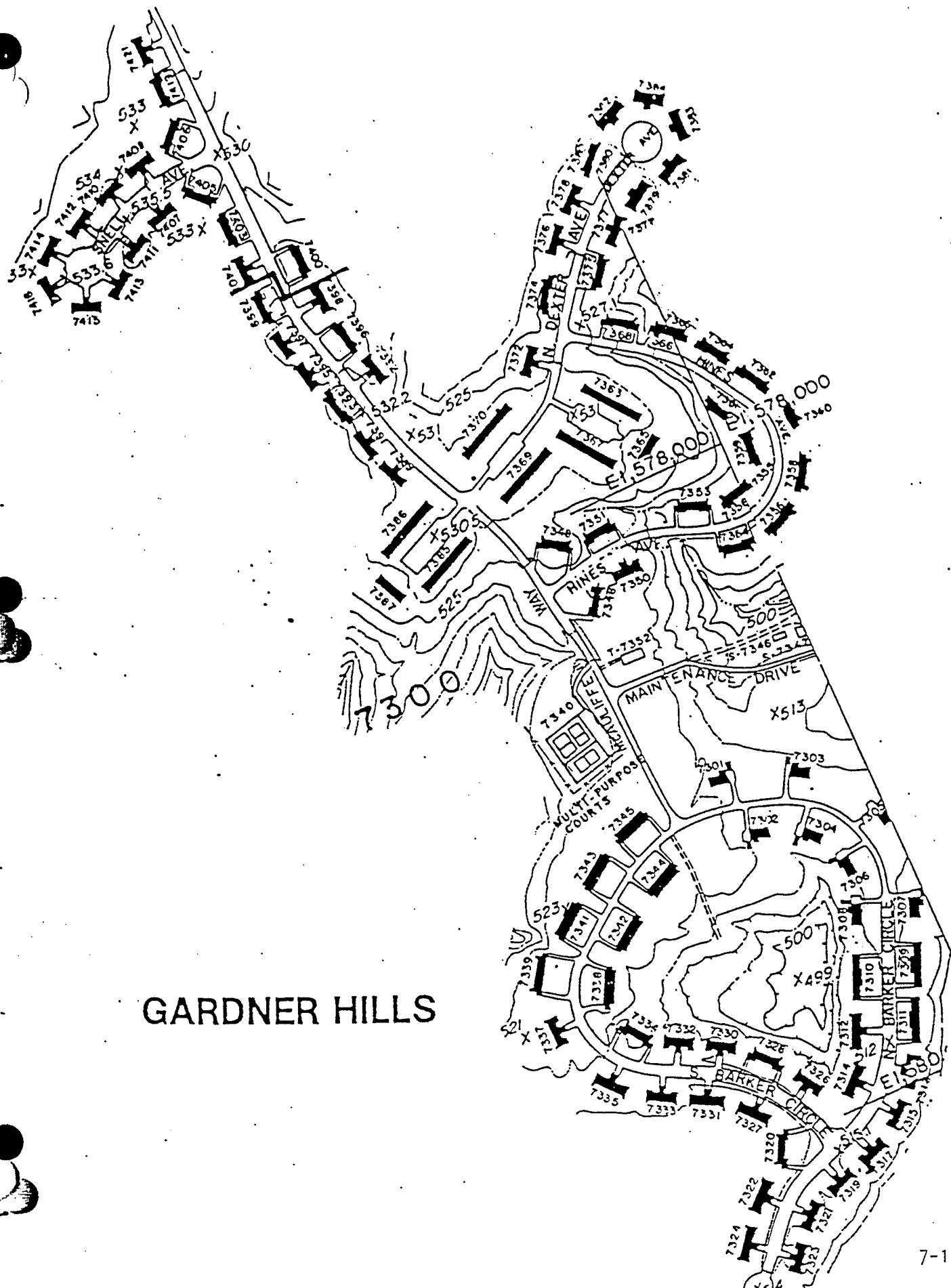




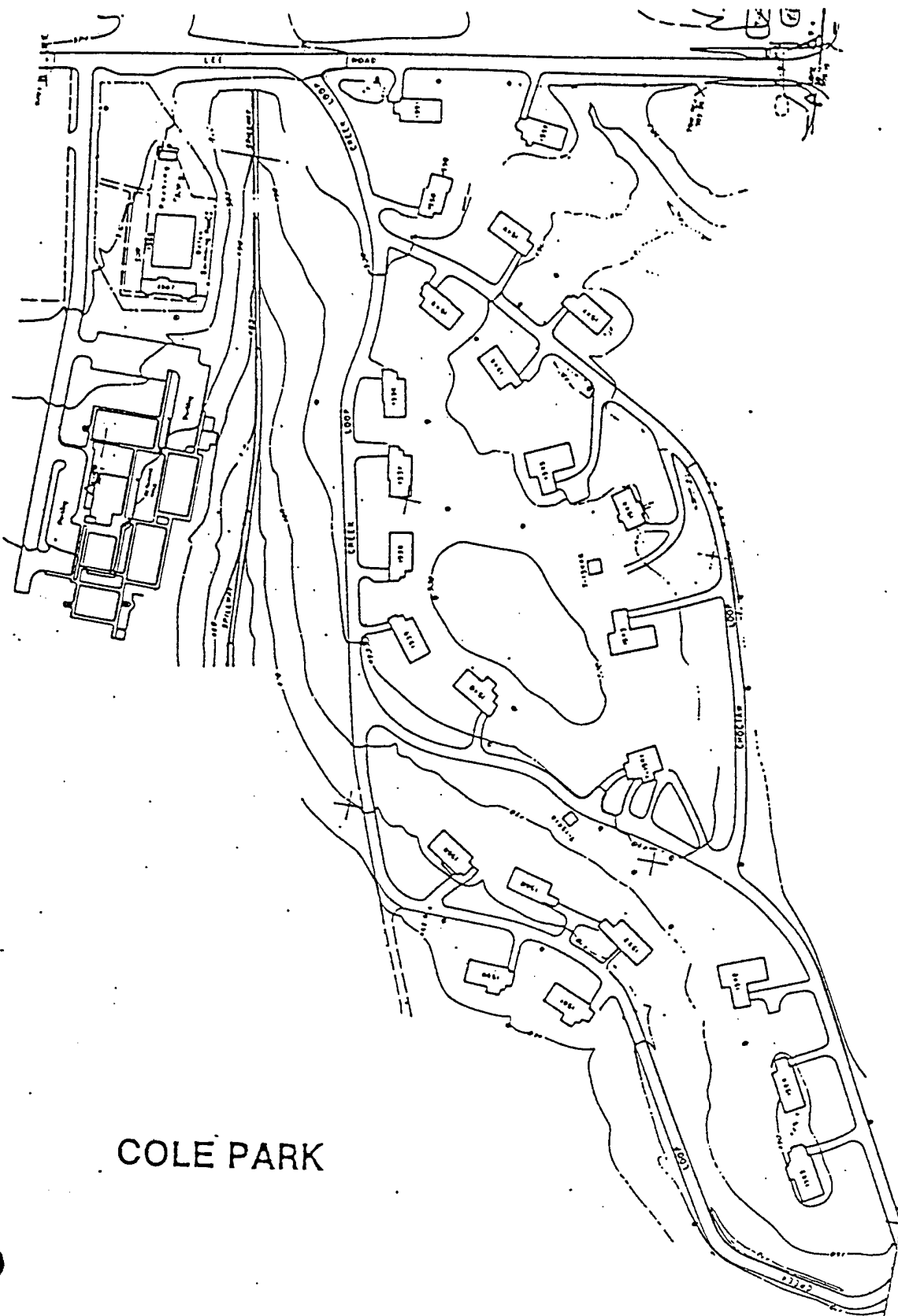


PIERCE VILLAGE

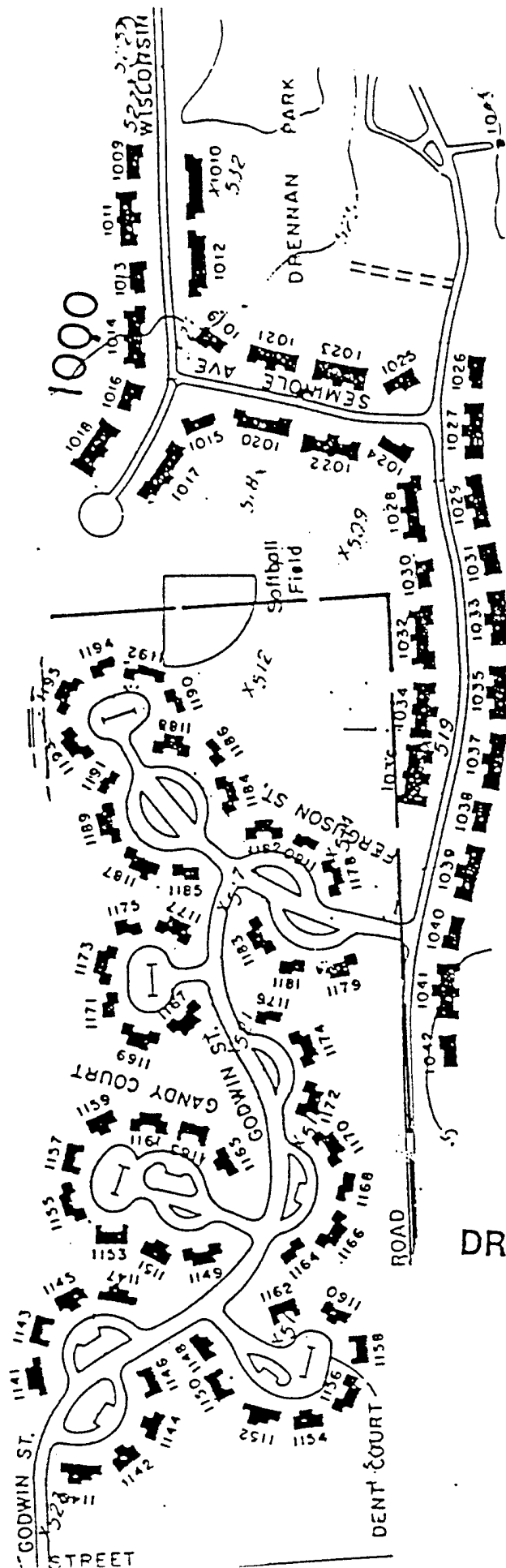




# GARDNER HILLS



COLE PARK



DRENNAN PARK



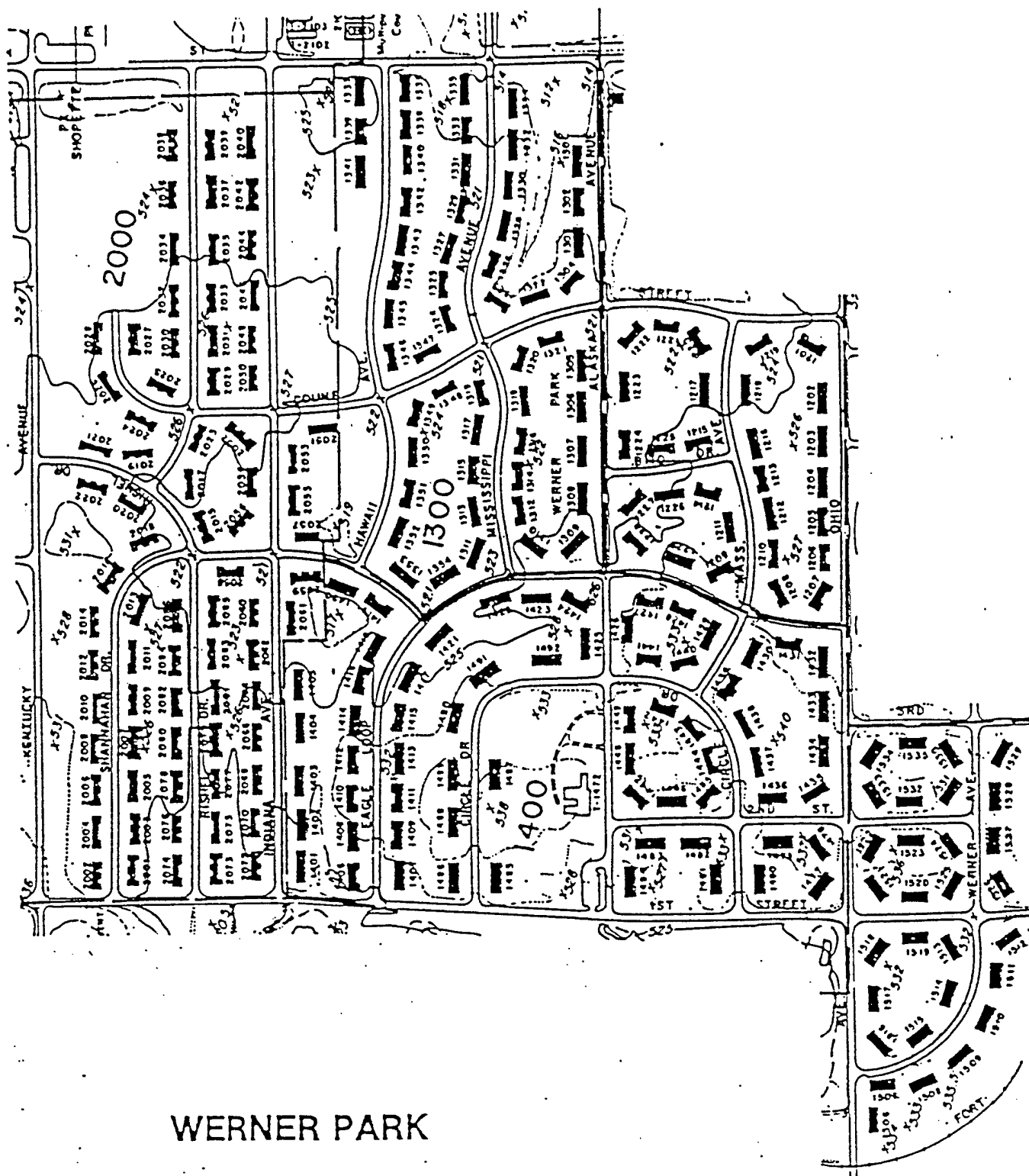


FIGURE B-6.1. SCHEDULE for the Phase I, and Phase II Option ESOS, FY93 EEAP, FORT CAMPBELL, KY, if awarded simultaneously:

<u>Item</u>	<u>Calendar Days</u>	<u>Actual Date</u>
1. CBD ANNOUNCEMENT.....	0 ..	16 Mar 93
2. CBD CLOSED.....	0 ..	15 Apr 93
3. SOW APPROVED BY COE/DEH/MACOM.....	0 ..	15 Apr 93
4. PRESELECTION/SELECTION BOARD.....	0 ..	6/7May 93
5. RFP LETTER TO A/E.....	0 ..	18 May 93
6. RFP LETTER RECEIVED BY A/E..... (COE, MACOM, DEH, and A/E coordinates date)	0 ..	20 May 93
7. ENTRY INTERVIEW @ Fort Campbell (FC)..... (prior to Pre-negotiation SOW Mtg. DEH, COE, and A/E)	0 ..	27 May 93
8. PRE-NEGOTIATION SCOPING MEETING @ FC..... (for RFP, neg'ns, scoping w/DEH,COE,MACOM,et.al.)	0 ..	27 May 93
9.a A/E SUBMITS PROPOSAL/NEG'Ns BEGIN.....	0 ..	10 Jun 93
b Negotiations begin/ends		14-18J 93
10. AWARDability CONTRACT-START/NTP..... (field analysis begins by A/E)	1 ..	28-30J 93
11. INTERIM SUBMITTAL..... (all field work completed/ECOs analyzed)	60 ..	01 Sep 93
12. REVIEW PERIOD OF THE INTERIM SUBMITTAL..... (COE gathers comments from IN-HOUSE/DEH/MACOM)	75 ..	15 Sep 93
13.a.INTERIM COMMENTS TO A/E (COE to A/E).....	76 ..	16 Sep 93
b.INTERIM CONFERENCE/ A/E PRESENTATION @ FC...	83 ..	22 Sep 93
14. PREFINAL SUBMITTAL.....	120 ..	01 Nov 93
15. REVIEW PERIOD.....	127 ..	08 Nov 93
16. PREFINAL CONFERENCE @ FC..... (COE, MACOM, DEH, and A/E presentation)	130 ..	11 Nov 93
17. EXIT INTERVIEW..... (COE, DEH, MP, and A/E)	130 ..	11 Nov 93
18. FINAL SUBMITTAL..... (A/E sends directly to listed-the ESOS)	175 ..	06 Dec 93
19. DEH SUBMITS DD form 1391's..... (A/E may be required to have input)	211 ..	03 Jan 94

NOTE: Option, Phase II, if awarded separately, will follow 9. through 18. as listed above for the schedule.



FIGURE B-7.1. Distribution of Submittals: The A/E shall make direct submittal and responses to comments as indicated by the following schedule:

<u>Organization</u>	<u>Correspondence</u>			
		<u>Executive Summary</u>		
		<u>Reports</u>	<u>Fieldnotes</u>	
COMMANDER, US Army Engineer District, Louisville ATTN: CEORL-ED-M/Charles Lockman P.O. Box 59 Louisville, KY 40201-0059 (tel. 502-582-6041, or fax# 6763, or 5281)	1	1	2	1*
HQ 101 Abn Div (AASLT) & Ft. Campbell ATTN: AF2B-DE-R-M/Arlin E. Wright 16th & Ohio St., Bldg. T-865 (DEH) Fort Campbell, KY 42223-1291 (tel. 502-798-8895, or fax# 9596)	1	1	2	1*
Headquarters FORSCOM (MACOM) ATTN: FCEN-RDF/Nareesh Kapur Fort McPherson, GA 30330-6000 (tel. 404-669-6731, or fax# 6122 or 7751)	1	1	1	1*
COMMANDER, US Army Engineer District, Mobile ATTN: CESAM-EN-CC/Tony Battaglia (EEAP TCX) P.O. Box 2288 Mobile, AL 36628-0001 (tel. 205-690-2618, or fax# 2424)	1	1**0		0
COMMANDER, US Army Engineer Div., Ohio River ATTN: CEORD-DL-M/Joe Semrad P.O. Box 1159 Cincinnati, OH 45201-1159 (tel. 513-684-3975)	0	1**0		0
COMMANDER, US Army Engineer Div., S. Atlantic ATTN: CESAD-EN-TE/John Baggett 77 Forsyth Street, S.W. Atlanta, GA 30335-6801	0	1**0		0
COMMANDER, US Army Corps of Engineers ATTN: CEMP-ET/Dan Gentil (EEAP Mgr.) 20 Massachusetts Avenue Washington, D.C. 20314-1000 (tel. 202-272-0430)	0	1**0		0
COMMANDER, US Army Logistics Evaluation Agency ATTN: LOEA-PL/Mr. Keath New Cumberland Army Depot New Cumberland, Pa. 17070-5006 * Field Notes submitted in final at Interim submittal. ** Submit copies of the final Executive Summary Only	0	1**0		0

# SYSTEMS<sub>corp</sub>

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION

---

November 5, 1993

Charles Lockman  
Commander, US Army Engineer District Louisville  
CEORL-ED-M  
P.O. Box 59  
Louisville, KY 40201-0059

Dear Mr. Lockman:

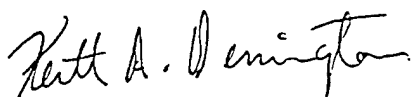
RE: Fort Campbell Energy Savings Opportunity Survey

Enclosed are the minutes from the Phase I Pre-Final review and the Phase II Interim review meeting at Fort Campbell held on October 22, 1993. Also enclosed are comments and responses for both submitted reports.

If you have any questions or require additional information, please call me at (615) 521-6536.

Sincerely,

SYSTEMS CORP



Keith Derrington  
Vice President

cc: Arlin Wright, AFZB-DE-R-M  
Naresh Kapur, FCEN-RDF  
Tony Battaglia, CESAM-EN-CC

Enclosures

Charles Lockman, CEORL-ED-M  
Page 2  
November 5, 1993

PREFINAL REVIEW PHASE I AND INTERIM REVIEW PHASE II  
MEETING MINUTES  
OCTOBER 22, 1993

ATTENDANCE LIST:

Charles Lockman	Louisville District CEORL-ED-MS	(502) 582-6041
Arlin E. Wright	Ft. Campbell DPW-MESB	(502) 798-8895
Gary Griffith	Ft. Campbell DPW-MESB	(502) 798-8895
Naresh Kapur	FORSCOM Engineer FCEN-PWO	(404) 669-6731
Keith Derrington	Systems Corp Project Manager	(615) 521-6536
Cheri Martin	Systems Corp Project Engineer	(615) 521-6536

The meeting was begun at 8:00 a.m. The initial part of the meeting was spent discussing the review comments for the Pre-Final report for Phase I and the Interim report for Phase II made by Naresh Kapur. Each of Mr. Kapur's comments were addressed and resolved. A list of Mr. Kapur's comments for both reports, along with Charles Lockman's comments for the Phase II report, are included as an attachment to the minutes. It was determined that the Pre-Final review meeting would be moved from November 15, 1993 to November 10, 1993.

The remainder of the meeting was a Systems Corp slide presentation summary of the results found, to date, for Phase I and II. The presentation for Phase II showed the results obtained for each specific ECO along with a discussion of the ECO survey, calculations, and economic analysis results. The presentation for Phase I displayed the results obtained for specific project groupings determined at a previous meeting.

The meeting was adjourned at approximately 11:00 a.m.

Charles Lockman, CEORL-ED-M  
Page 3  
November 5, 1993

## Phase I Pre-Final

*Naresh Kapur*

### VOLUME 1

*Comment 1* General

Based on experience with Phase 1 and Phase 2, please recommend what other buildings and what kinds of ECOs should be pursued to reduce energy consumption significantly. This can be a 1 to 2 page write-up.

*Response:*

Will respond in a separate write-up.

*Comment 2* Sect. 1.2.2

What is the purpose of this sub-paragraph? Maybe consider explaining sequence in which this report is organized.

*Response:*

Will expand with description of each volume.

*Comment 3* Fig. 1.3.1 & 1.3.2

Provide Units of Cost and MCF on Y-axis. Can the height of MCFs be comparable to cost?

*Response:*

Will comply.

*Comment 4* Table 1.3.2

Consider separating kwh cost and demand charges part in this table.

*Response:*

Will comply.

*Comment 5* Table 1.4.3

Provide overall figures for SIR and SPB.

Charles Lockman, CEORL-ED-M

Page 4

November 5, 1993

*Response:*

Will provide an average value.

*Comment 6* Section 1

The economics of chiller project is different here than presented in interim review view graph at the end of this report. Explain.

*Response:*

Buildings scheduled to be destroyed were removed from the project. This will be noted in the final report.

*Comment 7* Section 2

Provide SF for Building 4601, Child Care Center.

*Response:*

Arlin Wright will provide.

*Comment 8* Section 2

Based on data collected on chillers, is it possible to replace existing chillers by two smaller units, for handling partial loads and provide better economics? Please discuss.

*Response:*

Withdrawn.

*Comment 9* Section 2

Add titles following ECO number wherever needed.

*Response:*

Will comply.

*Comment 10* Section 2

Explain different replacement options in detail - in layman's language.

*Response:*

Will comply.

*Comment 11* Section 4

What part of the constuction cost is used in replacement cost (3B). Also provide PB and AIRR figures. Similar situations exist for other ECIPs.

Charles Lockman, CEORL-ED-M

Page 5

November 5, 1993

*Response:*

The report will be revised to explain the replacement cost at the front of the programming document.

*Comment 12* Section 1

Scope of work can be in more detail explaining existing conditions, final conditions, special situations, and different treatment for different areas for FC requirement point of view.

*Response:*

Withdrawn.

## VOLUME 2

*Comment 13* Section 4

Do we have LCCA for each building where lighting ECOs are considered? If so, where do we look?

*Response:*

These are included in the Interim Report.

## VOLUME 3

*Comment 14* Section 5

For all ECIP front pages, use ECIP guidance and round off dollar figures accordingly.

*Response:*

Will comply.

*Comment 15* Section 5

How to verify figures used in 3A and 3B of LCCA? Add PB and AIRR figures wherever missing for Special Requirement, Paragraph 1.

*Response:*

Refer to comment 11.

Charles Lockman, CEORL-ED-M  
Page 6  
November 5, 1993

*Comment 16* Section 7

Last sentence "please refer to section 4 for detailed description of the ECO". Please provide a real detailed description we can give NAF folks with the analysis for their further action.

*Response:*

Will comply.

Phase II Interim

*Naresh Kapur*

VOLUME 1-6

*Comment 1* General

This interim submittal is well documented. In next submittal, mention how many buildings and total SF is covered by this study (Phase 1 and Phase 2). What areas, especially large facilities, are not covered? This can be part of the Executive Summary write-up.

*Response:*

Will include as separate write-up.

VOLUME 1

*Comment 2* Section 2

Add titles following ECO numbers.

*Response:*

Will comply.

*Comment 3* Section 3.1.1

Paragraph 3, cross reference as to where expanded description of each ECO can be found. An ECO like #3, Indoor/Outdoor Lighting has many variations. Each need to be described in simple language. Provide catalog type information wherever possible.

*Response:*

Will comply in Pre-Final report.

Charles Lockman, CEORL-ED-M  
Page 7  
November 5, 1993

## VOLUME 1-2

*Comment 4* Section 5

Under "Project Notes" for ECO-6, Building 6734, it would be very helpful to document what is the current situation and what is being done as part of this ECO. Just repeating generic scope of work each time is not acceptable. This comment applies to other buildings under this ECO and other ECOs also.

*Response:*

Withdrawn. Covered in spreadsheets.

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Page 5-215, Project Number 006-6904, credit is not applied for future cost avoidance (Item 3B of LCCA). The credit is applied for many similar ECOs but not all. Please explain.

*Response:*

Will explain in Pre-Final report.

## VOLUME 2

*Comment 5* Section 5

Please explain each item of the cost estimate. Do the fixtures come assembled, ready to be installed? If not, investigate the possibilities labor saving can be significant. This is applicable to similar ECOs in other buildings.

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Charles Lockman, CEORL-ED-M  
Page 8  
November 5, 1993

these figures are picked up. This situation may be applicable to other ECOs also. Please check.

*Response:* Will explain

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*Comment 8* Section 6 Elaborate the Scope of Work in sufficient details as to how this ECO works. Spell out the work involved and any change of current operation. Is there any requirement of additional maintenance and repairs? Provide sketches, etc., as needed.

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Charles Lockman, CEORL-ED-M  
Page 9  
November 5, 1993

*Response:*

Will add explanation.

#### VOLUME 4

*Comment 12* Section 10

Describe Scope of Work in more detail. Discuss current light level and anticipated light level in different areas. We need to provide details to commissary organization for further action. The ECO analysis look good.

*Response:*

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*Comment 13* Section 11

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*Response:*

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#### VOLUME 5

*Comment 14* Section 15

Please explain how overlit areas have been dealt with. Is delamping some fixtures considered/suggested? Is lower light level needs in corridor areas and toilets recognized in ECOs? (Example: Buildings 6901, 6908, and 6907.)

*Response:*

Refer to Section 5-1, Interim report.

Charles Lockman, CEORL-ED-M  
Page 10  
November 5, 1993

Phase II Interim

*Charles Lockman*

VOLUME 4

*Comment 1* Section 11

ECO-7: Peak-Shaving Generators took the place of Waste Heat Recovery-Heat Exchangers. Because this is the Narrative Summary, should we have either noted a change here, or ink change the SOW changed as result of, etc.? (This is to help others later looking at reports)

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11.3.6 ECO-11: Commissary Lighting (same as Comment 1). This ECO was added/picked up as result of ECO #7 not up front have good positive results. This ECO and ECO 7 were studied. Again, this is for summary consideration.

*Response:*

Will note the change.

# SYSTEMS<sub>corp</sub>

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION

---

November 5, 1993

Charles Lockman  
Commander, US Army Engineer District Louisville  
CEORL-ED-M  
P.O. Box 59  
Louisville, KY 40201-0059

Dear Mr. Lockman:

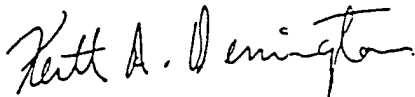
RE: Fort Campbell Energy Savings Opportunity Survey

Enclosed are the minutes from the Phase I Pre-Final review and the Phase II Interim review meeting at Fort Campbell held on October 22, 1993. Also enclosed are comments and responses for both submitted reports.

If you have any questions or require additional information, please call me at (615) 521-6536.

Sincerely,

SYSTEMS CORP



Keith Derrington  
Vice President

cc: Arlin Wright, AFZB-DE-R-M  
Naresh Kapur, FCEN-RDF  
Tony Battaglia, CESAM-EN-CC

Enclosures

Charles Lockman, CEORL-ED-M  
Page 2  
November 5, 1993

PREFINAL REVIEW PHASE I AND INTERIM REVIEW PHASE II  
MEETING MINUTES  
OCTOBER 22, 1993

ATTENDANCE LIST:

Charles Lockman	Louisville District CEORL-ED-MS	(502) 582-6041
Arlin E. Wright	Ft. Campbell DPW-MESB	(502) 798-8895
Gary Griffith	Ft. Campbell DPW-MESB	(502) 798-8895
Naresh Kapur	FORSCOM Engineer FCEN-PWO	(404) 669-6731
Keith Derrington	Systems Corp Project Manager	(615) 521-6536
Cheri Martin	Systems Corp Project Engineer	(615) 521-6536

The meeting was begun at 8:00 a.m. The initial part of the meeting was spent discussing the review comments for the Pre-Final report for Phase I and the Interim report for Phase II made by Naresh Kapur. Each of Mr. Kapur's comments were addressed and resolved. A list of Mr. Kapur's comments for both reports, along with Charles Lockman's comments for the Phase II report, are included as an attachment to the minutes. It was determined that the Pre-Final review meeting would be moved from November 15, 1993 to November 10, 1993.

The remainder of the meeting was a Systems Corp slide presentation summary of the results found, to date, for Phase I and II. The presentation for Phase II showed the results obtained for each specific ECO along with a discussion of the ECO survey, calculations, and economic analysis results. The presentation for Phase I displayed the results obtained for specific project groupings determined at a previous meeting.

The meeting was adjourned at approximately 11:00 a.m.

Charles Lockman, CEORL-ED-M  
Page 3  
November 5, 1993

Phase I Pre-Final

*Naresh Kapur*

### VOLUME 1

*Comment 1* General

Based on experience with Phase 1 and Phase 2, please recommend what other buildings and what kinds of ECOs should be pursued to reduce energy consumption significantly. This can be a 1 to 2 page write-up.

*Response:*

Will respond in a separate write-up.

*Comment 2* Sect. 1.2.2

What is the purpose of this sub-paragraph? Maybe consider explaining sequence in which this report is organized.

*Response:*

Will expand with description of each volume.

*Comment 3* Fig. 1.3.1 & 1.3.2

Provide Units of Cost and MCF on Y-axis. Can the height of MCFs be comparable to cost?

*Response:*

Will comply.

*Comment 4* Table 1.3.2

Consider separating kwh cost and demand charges part in this table.

*Response:*

Will comply.

*Comment 5* Table 1.4.3

Provide overall figures for SIR and SPB.

Charles Lockman, CEORL-ED-M

Page 4

November 5, 1993

*Response:*

Will provide an average value.

*Comment 6* Section 1

The economics of chiller project is different here than presented in interim review view graph at the end of this report. Explain.

*Response:*

Buildings scheduled to be destroyed were removed from the project. This will be noted in the final report.

*Comment 7* Section 2

Provide SF for Building 4601, Child Care Center.

*Response:*

Arlin Wright will provide.

*Comment 8* Section 2

Based on data collected on chillers, is it possible to replace existing chillers by two smaller units, for handling partial loads and provide better economics? Please discuss.

*Response:*

Withdrawn.

*Comment 9* Section 2

Add titles following ECO number wherever needed.

*Response:*

Will comply.

*Comment 10* Section 2

Explain different replacement options in detail - in layman's language.

*Response:*

Will comply.

*Comment 11* Section 4

What part of the constuction cost is used in replacement cost (3B). Also provide PB and AIRR figures. Similar situations exist for other ECIPs.

Charles Lockman, CEORL-ED-M  
Page 5  
November 5, 1993

*Response:*

The report will be revised to explain the replacement cost at the front of the programming document.

*Comment 12* Section 1

Scope of work can be in more detail explaining existing conditions, final conditions, special situations, and different treatment for different areas for FC requirement point of view.

*Response:*

Withdrawn.

## VOLUME 2

*Comment 13* Section 4

Do we have LCCA for each building where lighting ECOs are considered? If so, where do we look?

*Response:*

These are included in the Interim Report.

## VOLUME 3

*Comment 14* Section 5

For all ECIP front pages, use ECIP guidance and round off dollar figures accordingly.

*Response:*

Will comply.

*Comment 15* Section 5

How to verify figures used in 3A and 3B of LCCA? Add PB and AIRR figures wherever missing for Special Requirement, Paragraph 1.

*Response:*

Refer to comment 11.



Charles Lockman, CEORL-ED-M  
Page 6  
November 5, 1993

*Comment 16* Section 7

Last sentence "please refer to section 4 for detailed description of the ECO". Please provide a real detailed description we can give NAF folks with the analysis for their further action.

*Response:*

Will comply.

Phase II Interim

*Naresh Kapur*

VOLUME 1-6

*Comment 1* General

This interim submittal is well documented. In next submittal, mention how many buildings and total SF is covered by this study (Phase 1 and Phase 2). What areas, especially large facilities, are not covered? This can be part of the Executive Summary write-up.

*Response:*

Will include as separate write-up.

VOLUME 1

*Comment 2* Section 2

Add titles following ECO numbers.

*Response:*

Will comply.

*Comment 3* Section 3.1.1

Paragraph 3, cross reference as to where expanded description of each ECO can be found. An ECO like #3, Indoor/Outdoor Lighting has many variations. Each need to be described in simple language. Provide catalog type information wherever possible.

*Response:*

Will comply in Pre-Final report.

Charles Lockman, CEORL-ED-M  
Page 7  
November 5, 1993

## VOLUME 1-2

*Comment 4* Section 5

Under "Project Notes" for ECO-6, Building 6734, it would be very helpful to document what is the current situation and what is being done as part of this ECO. Just repeating generic scope of work each time is not acceptable. This comment applies to other buildings under this ECO and other ECOs also.

*Response:*

Withdrawn. Covered in spreadsheets.

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*Response:*

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Please explain each item of the cost estimate. Do the fixtures come assembled, ready to be installed? If not, investigate the possibilities labor saving can be significant. This is applicable to similar ECOs in other buildings.

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Charles Lockman, CEORL-ED-M  
Page 8  
November 5, 1993

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### VOLUME 3

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Charles Lockman, CEORL-ED-M  
Page 9  
November 5, 1993

*Response:* Will add explanation.

#### VOLUME 4

*Comment 12* Section 10 Describe Scope of Work in more detail. Discuss current light level and anticipated light level in different areas. We need to provide details to commissary organization for further action. The ECO analysis look good.

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*Comment 13* Section 11 Delete D Project Non-energy qualification test. Add an item for Payback years.

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#### VOLUME 5

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Charles Lockman, CEORL-ED-M  
Page 10  
November 5, 1993

Phase II Interim

*Charles Lockman*

#### VOLUME 4

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10.1 PHASE 1: COMMENTS

*Naresh Kapur*

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*Response:*

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Provide overall figures for SIR and SPB.

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## 10 INTERIM REVIEW COMMENTS AND RESPONSES

---

**Comment 6**    Section 1                      The economics of chiller project is different here than presented in interim review view graph at the end of this report. Explain.

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## 10 INTERIM REVIEW COMMENTS AND RESPONSES

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### VOLUME 2

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*Response:*

Will comply.

SYSTEMS/CORP

Knoxville, TN

10-3

10.2 PHASE 2: COMMENTS

*Naresh Kapur*

**VOLUME 1-6**

***Comment 1***    General

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**VOLUME 1**

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## 10 INTERIM REVIEW COMMENTS AND RESPONSES

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VOLUME 4

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VOLUME 5

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*Charles Lockman*

VOLUME 4

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*Response:*

Will note the change.

# ENERGY SAVINGS OPPORTUNITY SURVEY

Fort Campbell, Kentucky

*Phase II*

# FT. CAMPBELL FIELD SURVEY

- Conducted July 12 - July 20, 1993
- 133 Buildings Surveyed
- 5 Family Housing Areas Surveyed



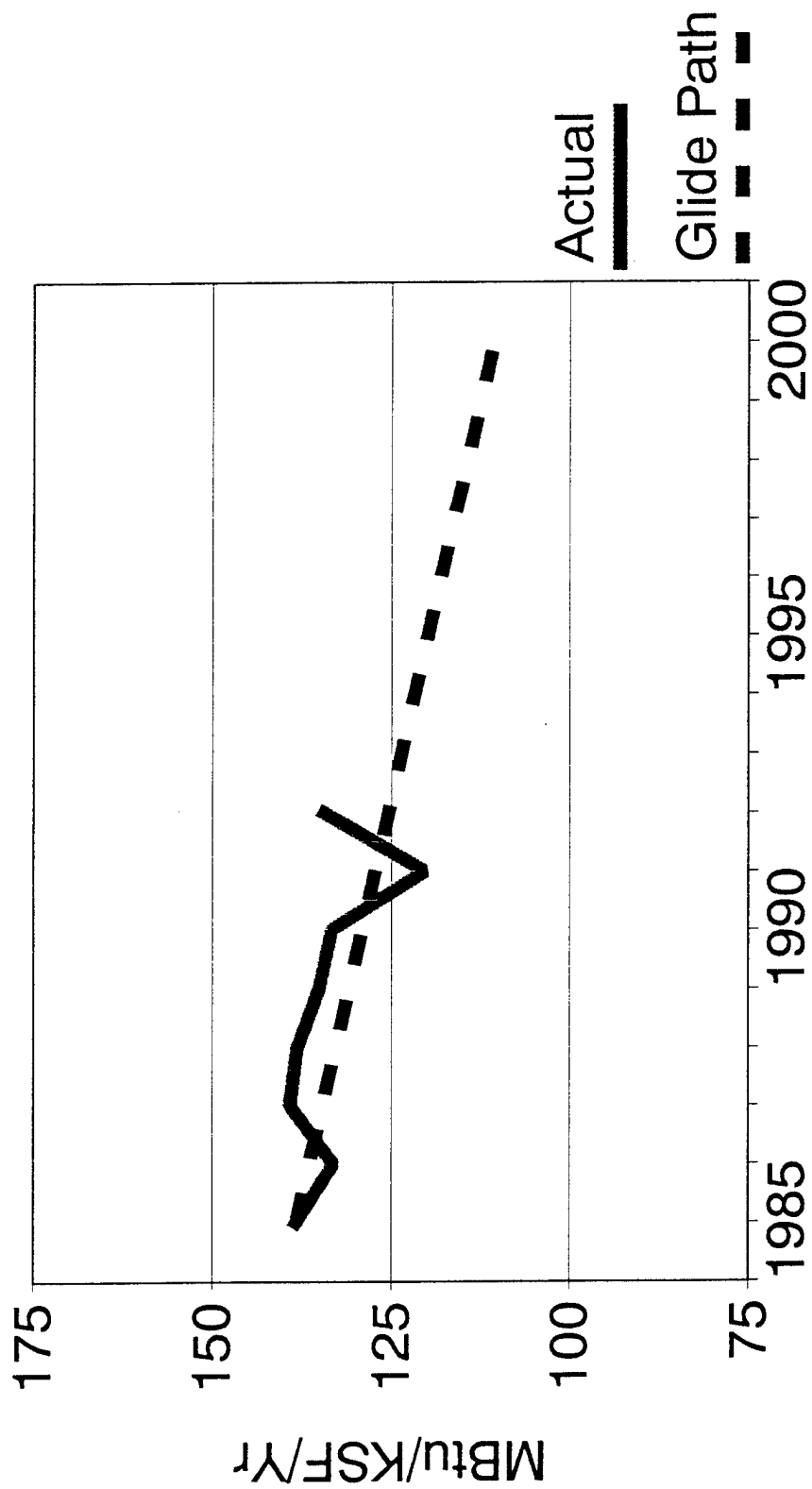
# WORK ACCOMPLISHED TO DATE

1. Field Surveys Completed for 133 Buildings
2. Exterior Lighting Surveys for 5 FH Areas
3. Baseline Energy Models
4. Evaluation of 121 Energy Conservation Opportunities
5. Calculations and Reporting of Solid Energy Conservation Opportunities for Possible Implementation
6. Preparation and Completion of all Field Notes
7. Completion of Interim Reports

# REMAINING PHASES

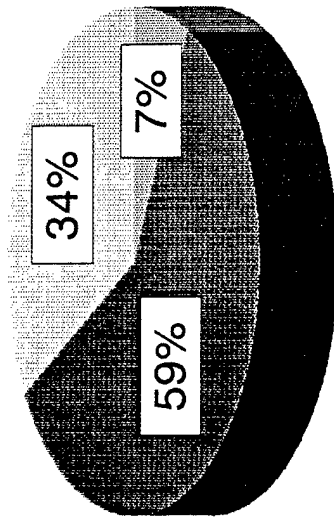
- Response to Interim Review Comments
- Preparation of Programming and Implementation Documents
- Prefinal Report
- Response to Prefinal Report Comments
- Final Report

# Fort Campbell Energy Consumption

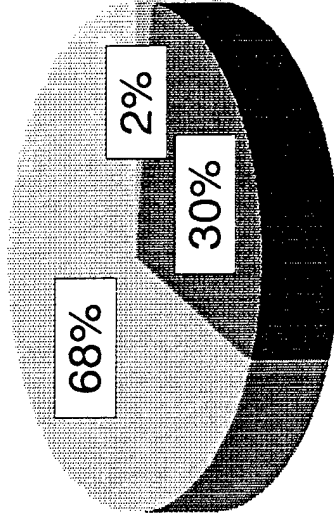


# Fort Campbell Consumption vs. Cost

FY92



2,379,660 MBtu



\$16,599,000

Electricity    Natural Gas    Other

# FT CAMPBELL ENERGY COSTS

Electric	
Energy	\$6.19/MBtu
<i>with Demand</i>	\$13.48/MBtu
Natural Gas	\$4.00/MBtu
Fuel Oil	\$4.98/MBtu

# ENERGY CONSERVATION OPPORTUNITIES

- ECO-6:    A. Indoor Lighting  
             B. Street Lighting
- ECO-7:    Waste Heat Recovery & Peak Shaving Generators
- ECO-8:    Chiller Replacement
- ECO-9:    Variable Speed Circulation Pumps
- ECO-10:   EMCS Expansion
- ECO-11:   Commissary Lighting

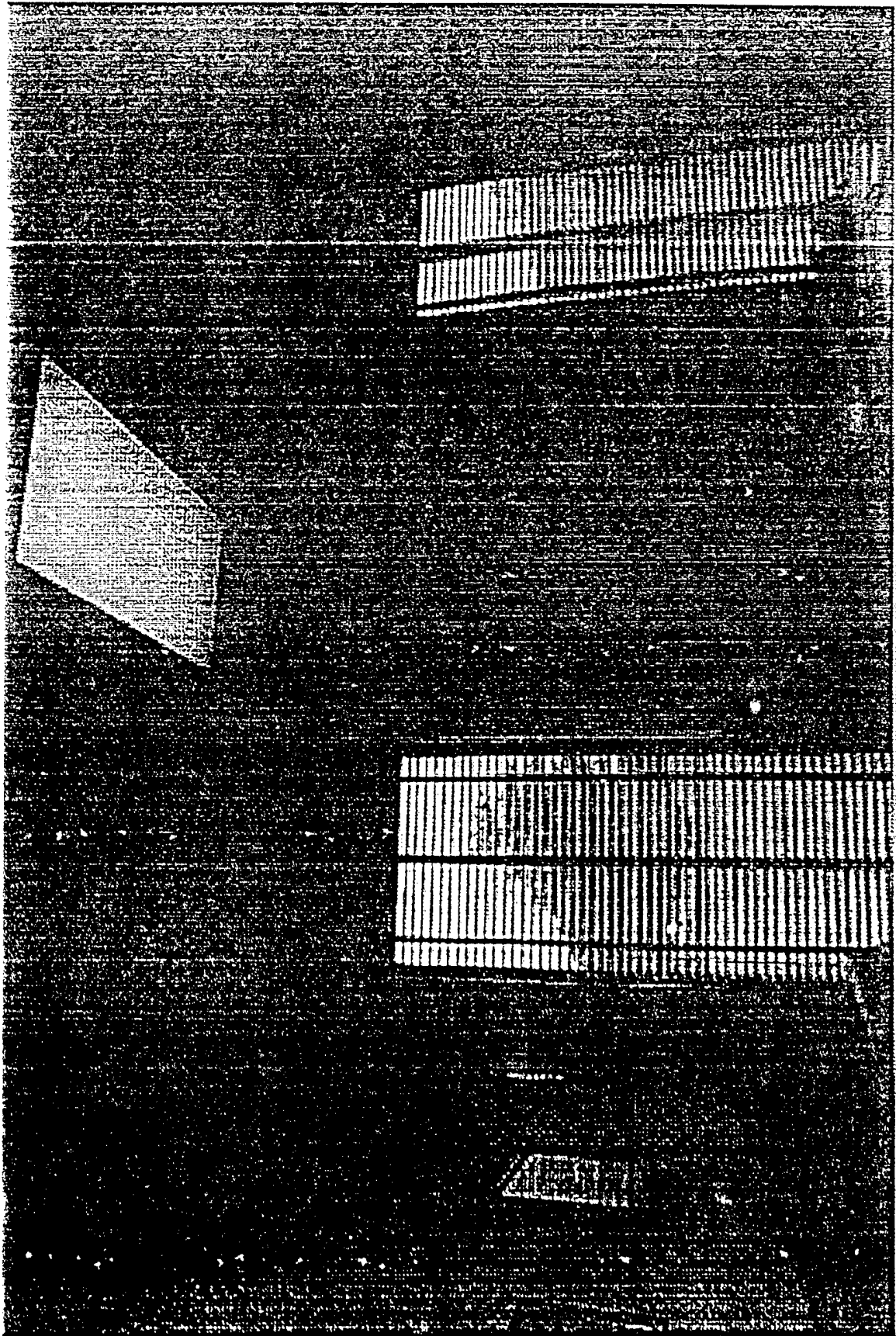
## ECO-6: Indoor/Outdoor Lighting

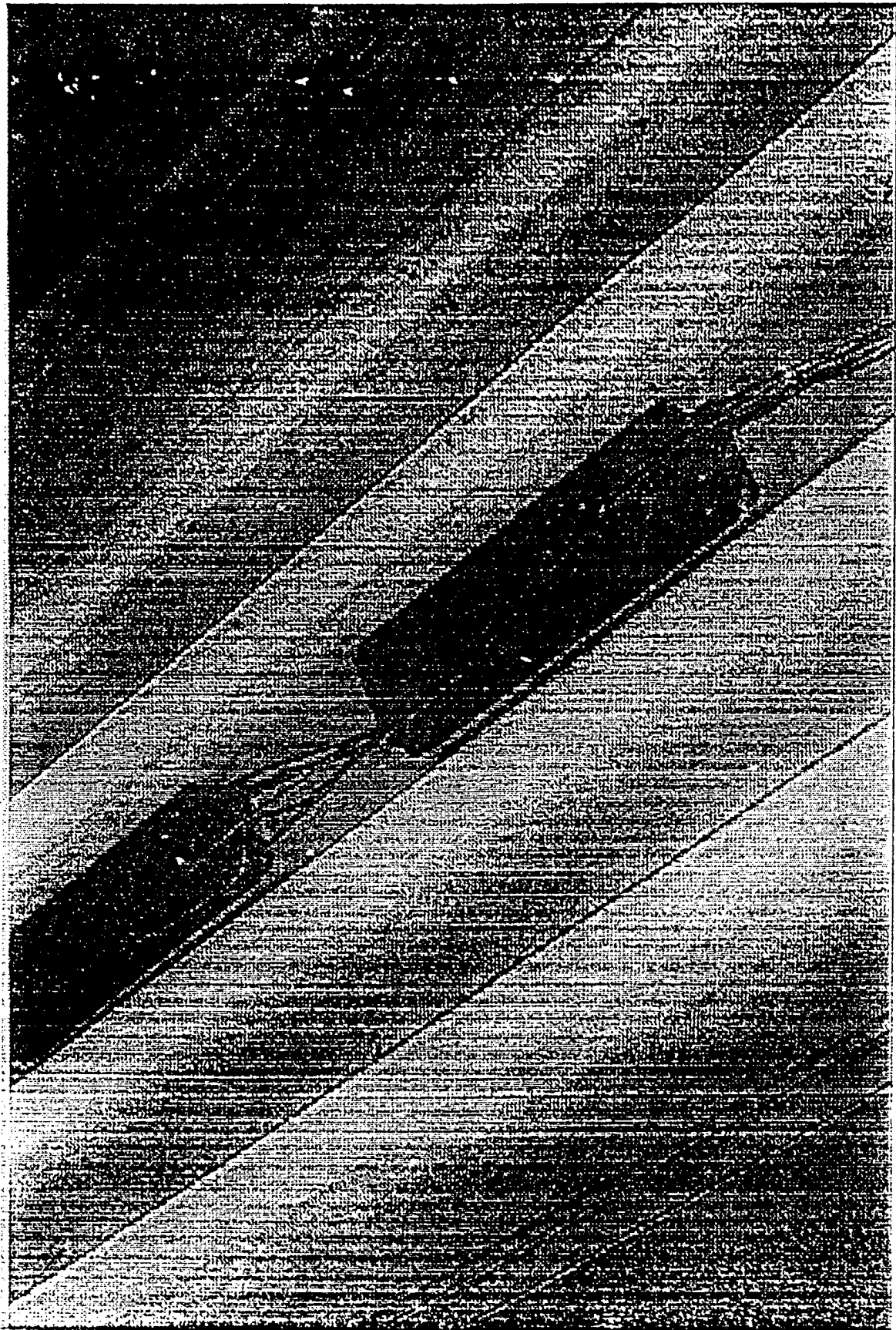
- 37 Buildings
- 5 Family Housing Area Surveyed

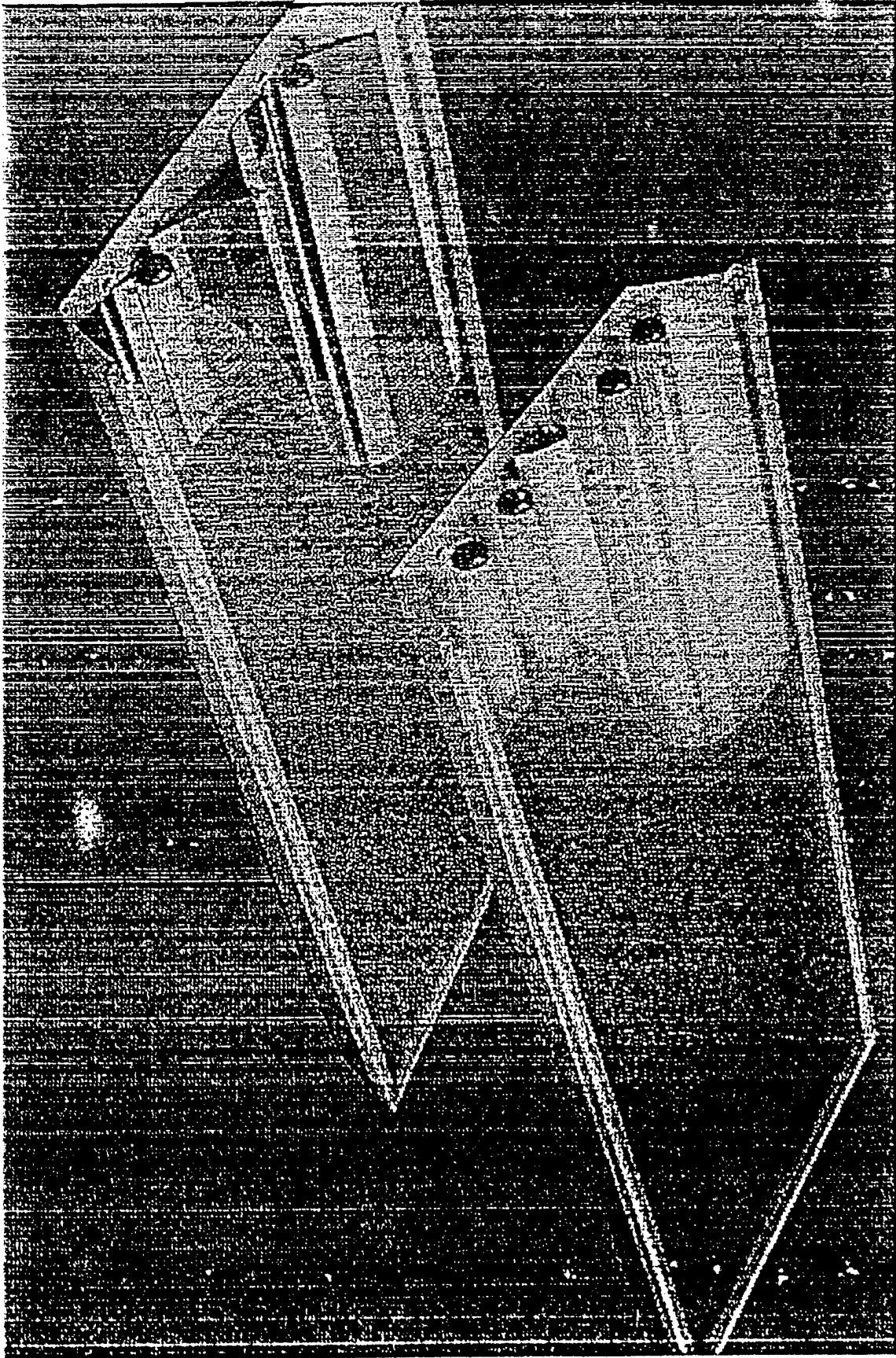
## ECO-6: Information Collected

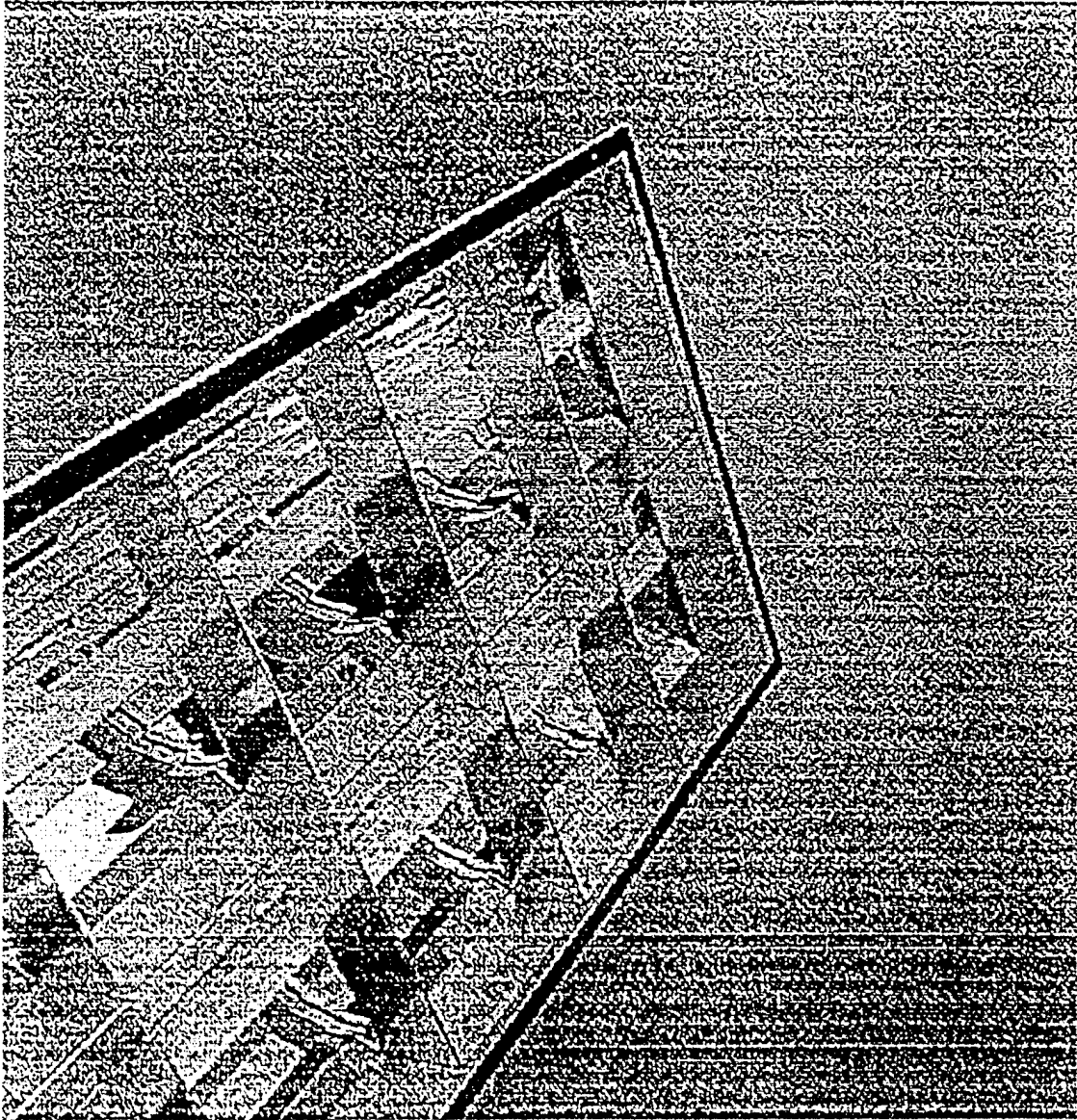
1. Building Hours of Use
2. Existing Fixture Type
3. Ballast Wattage
4. Lamp Wattage
5. Number of Fixtures
6. Applications for Occupancy Sensors

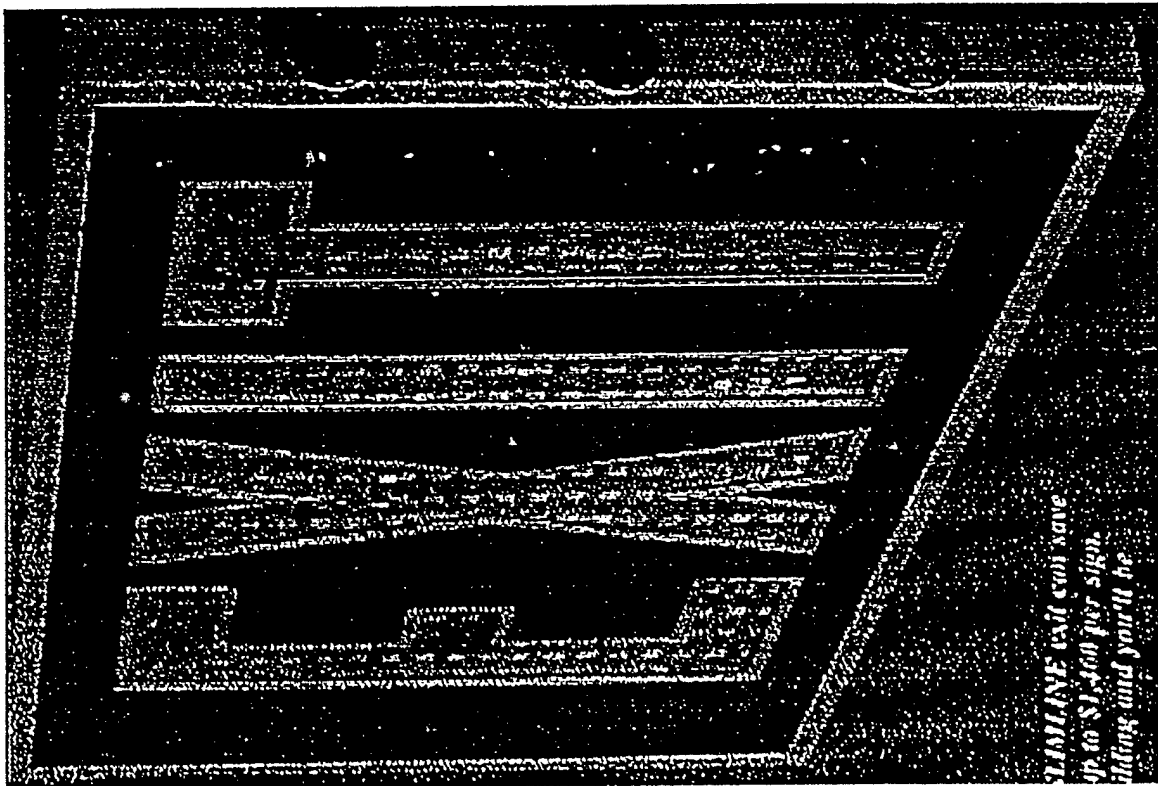




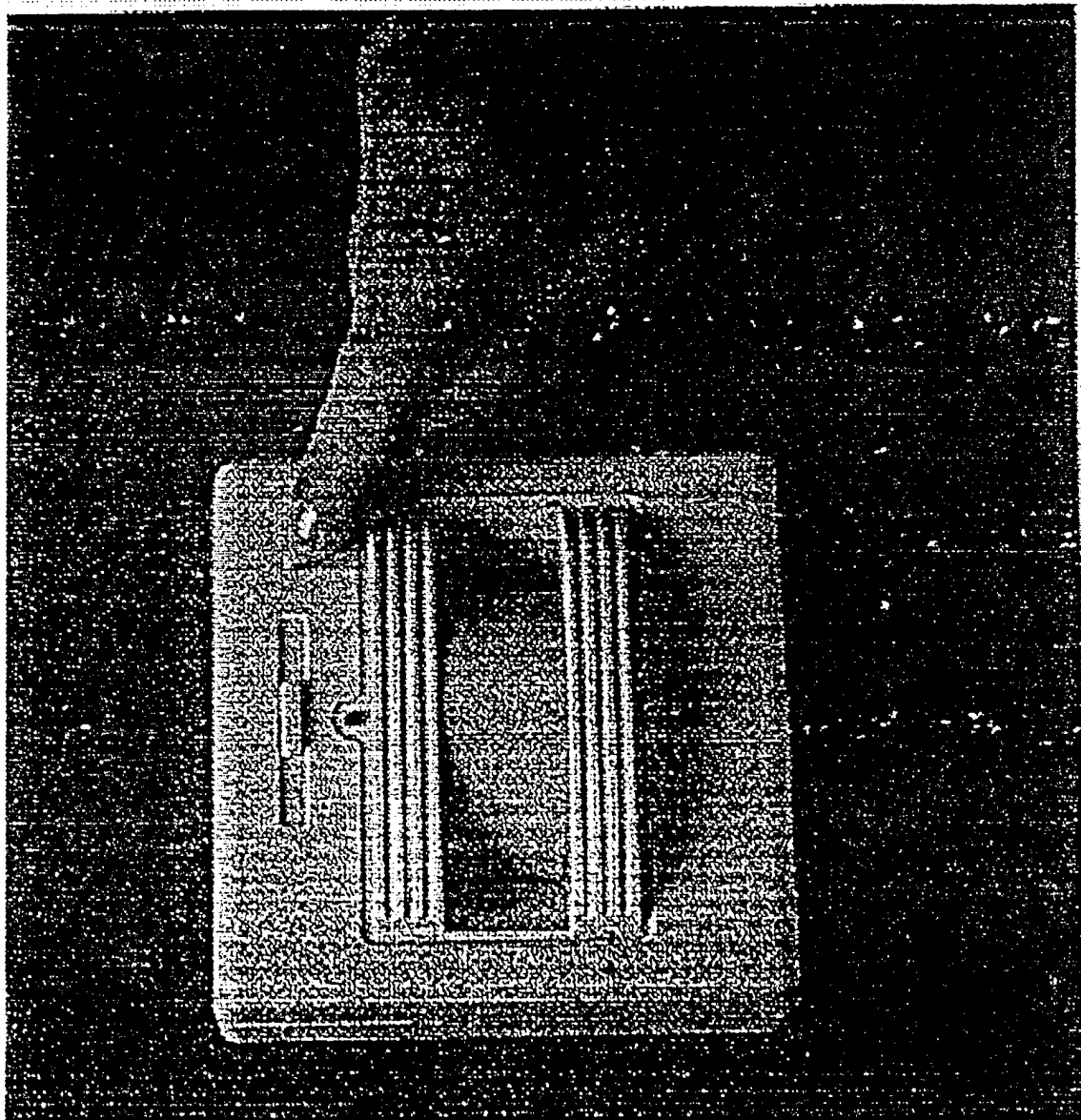












## ECO-6: Analysis Summary

Energy Savings	1709 MBtu/yr
Cost Savings	\$43,242/yr
Investment	\$349,993
SIR	1.39
SPB	8.09 yrs

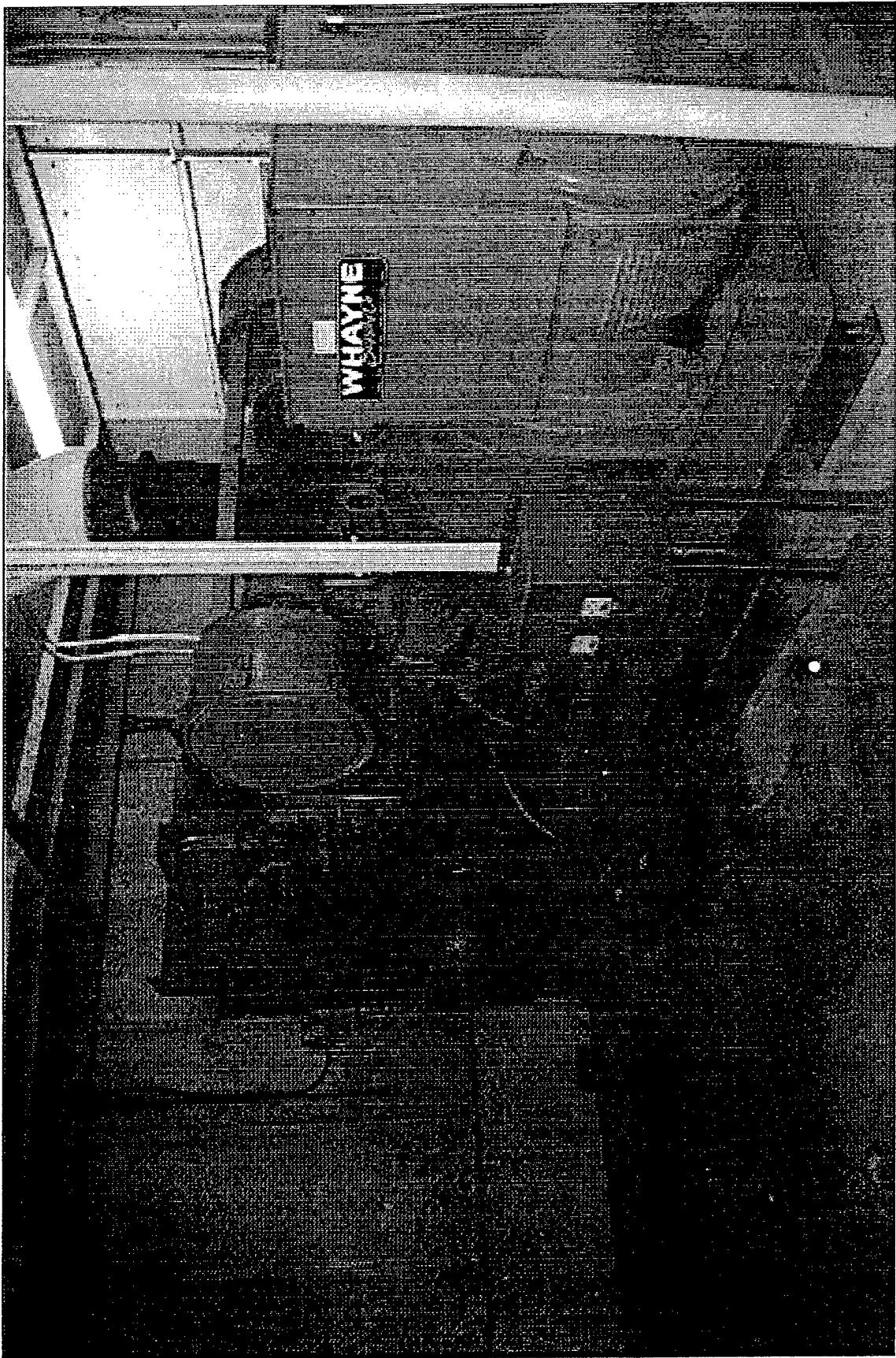
## ECO-7: Waste Heat Recovery & Peak Shaving Generators

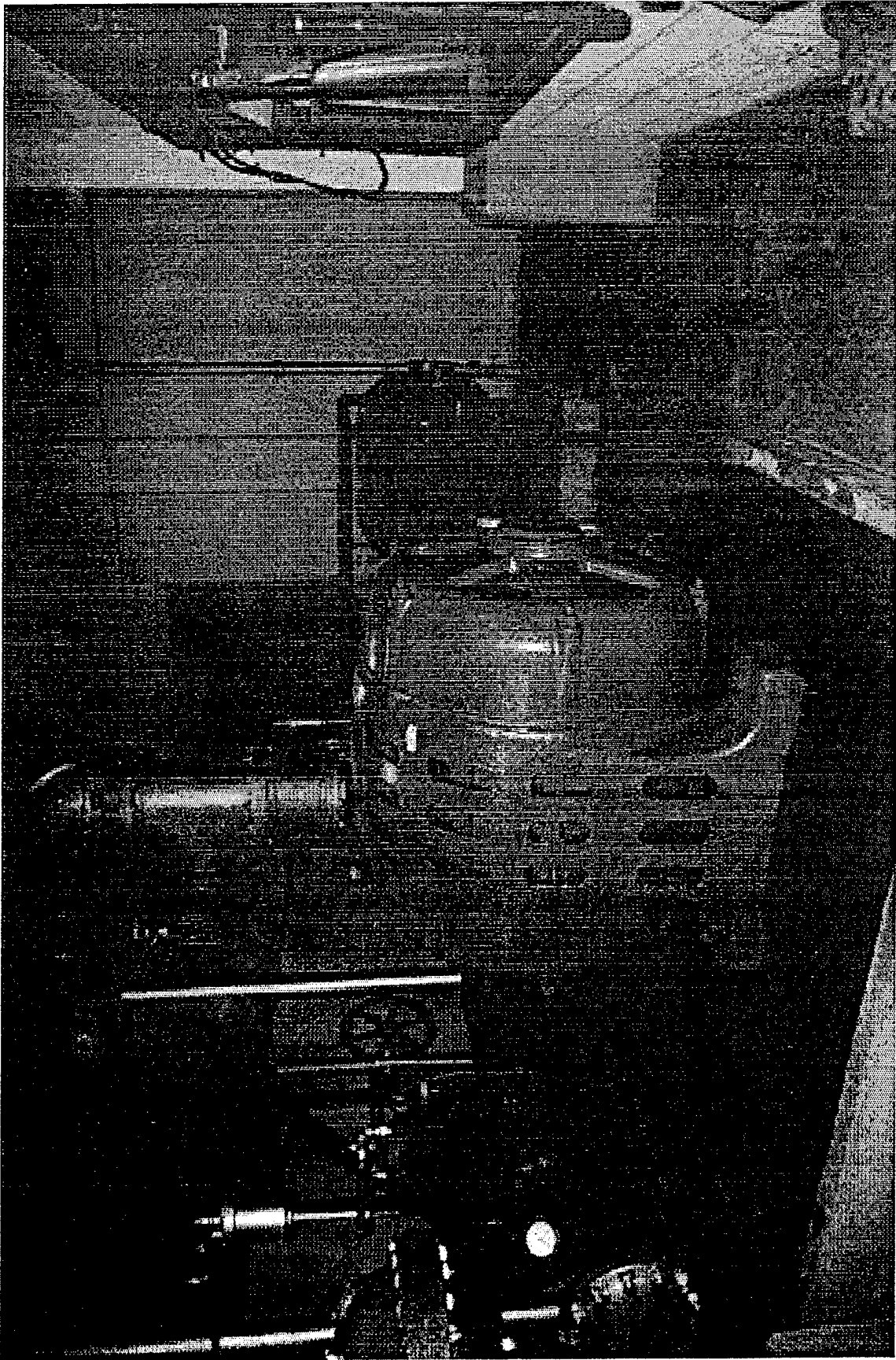
- 17 Buildings Surveyed

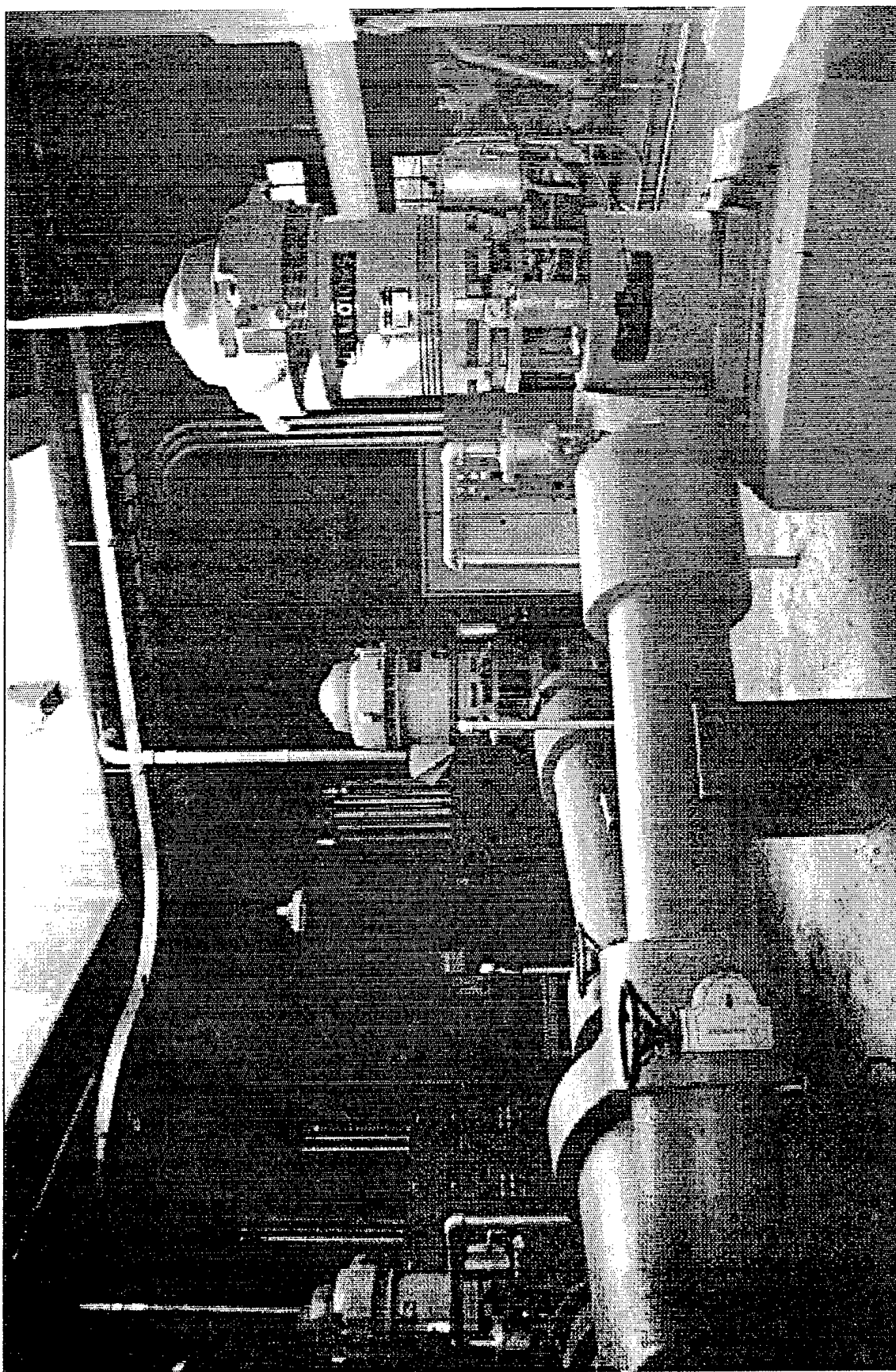


## ECO-7: Information Collected

1. Manufacturer, model and serial numbers from boilers and generators
2. Flue gas temperature from boilers
3. Operating temperature and pressure from boilers
4. O<sub>2</sub> and CO<sub>2</sub> readings from boilers
5. KW demand for generators
6. Hours of use for generators
7. Fuel storage capacity for generators







## ECO-7: Analysis Summary

Energy Savings	-12,910 MBtu/yr
Cost Savings	\$42,681/yr
Investment	\$49,913
SIR	5.33
SPB	1.17 yrs

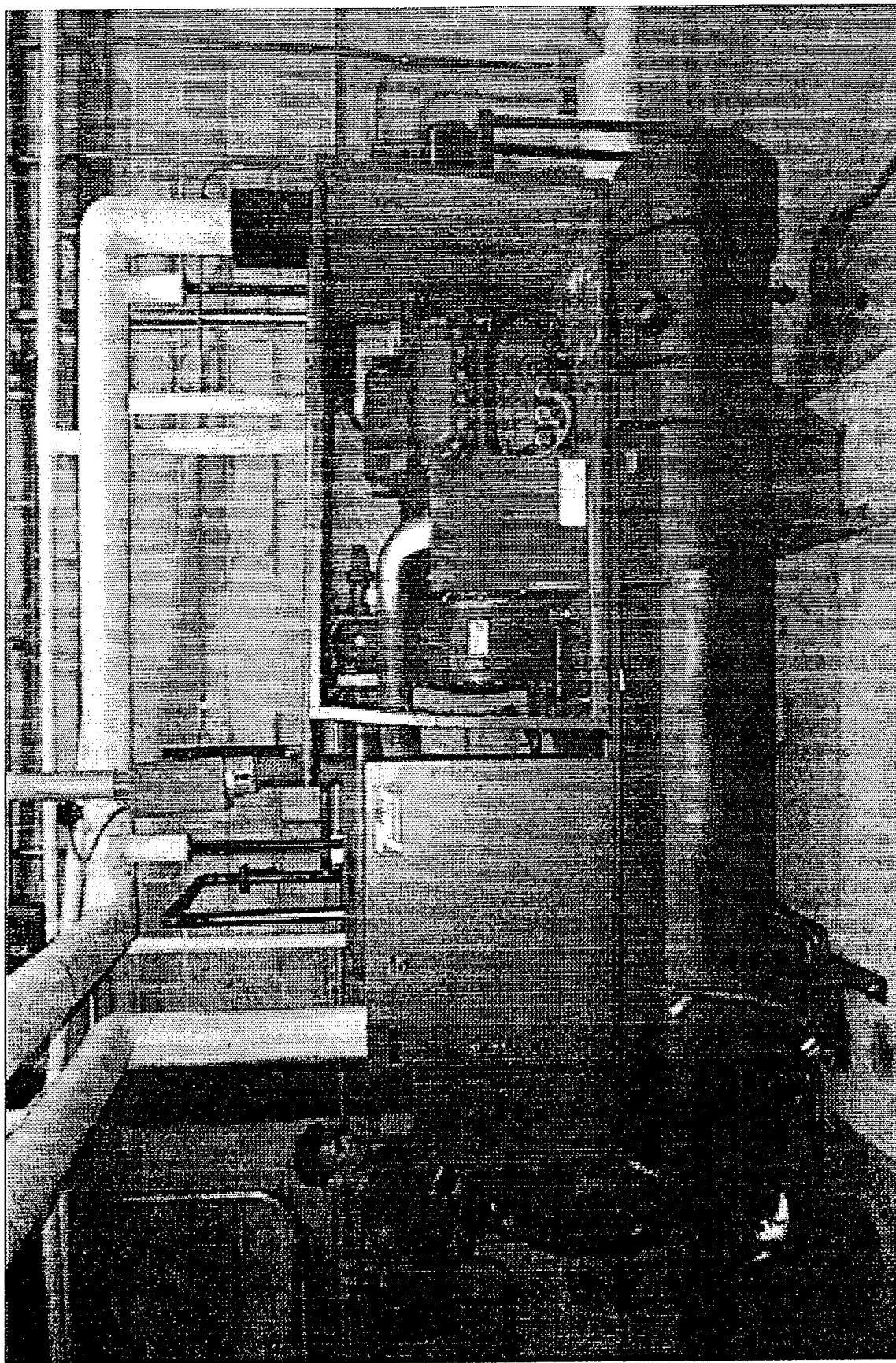
## ECO-8: Chiller Replacement

- 4 Buildings Surveyed

## ECO-8: Information Collected

1. Manufacturer, Model and Serial Numbers
2. Chilled Water Pump Data







## ECO-8: Savings and Replacement Costs

<i>Building#</i>	<i>Chiller Size</i>	<i>Energy Savings</i>	<i>Chiller Cost*</i>
38	60 Tons	\$375	\$27,000
93	70 Tons	1,592	\$32,900
95	45 Tons	1,023	\$22,900
98	75 Tons	1,705	\$35,150

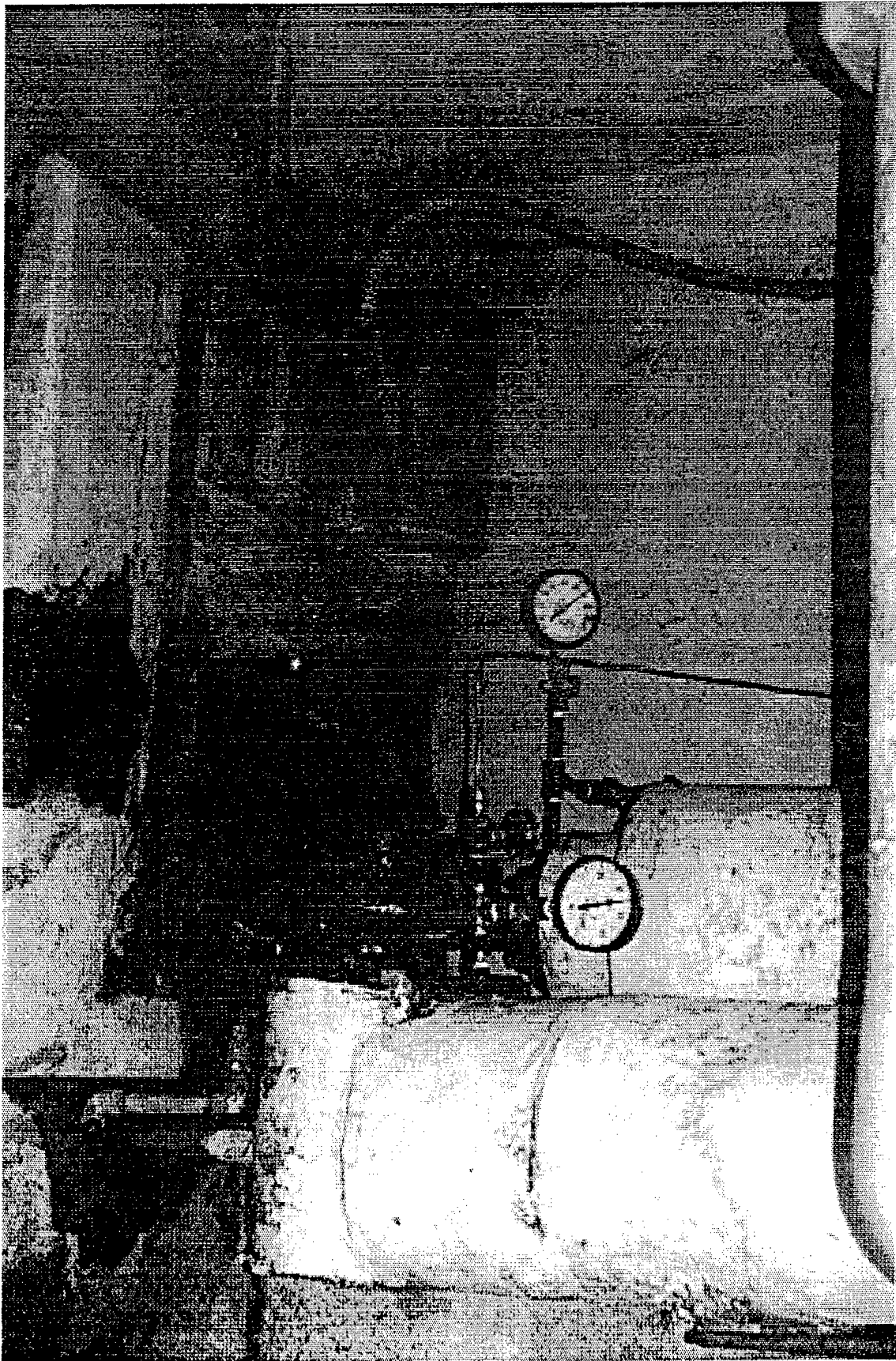
\* Chiller Cost does not Include Labor

## ECO-9: Variable Speed Circulation Pumps

- 57 Buildings Surveyed

## ECO-9: Information Collected

1. Motor Size
2. Motor Voltage
3. Type of Heating Controls (i.e. 3-Way Valves)



## ECO-9: Analysis Summary

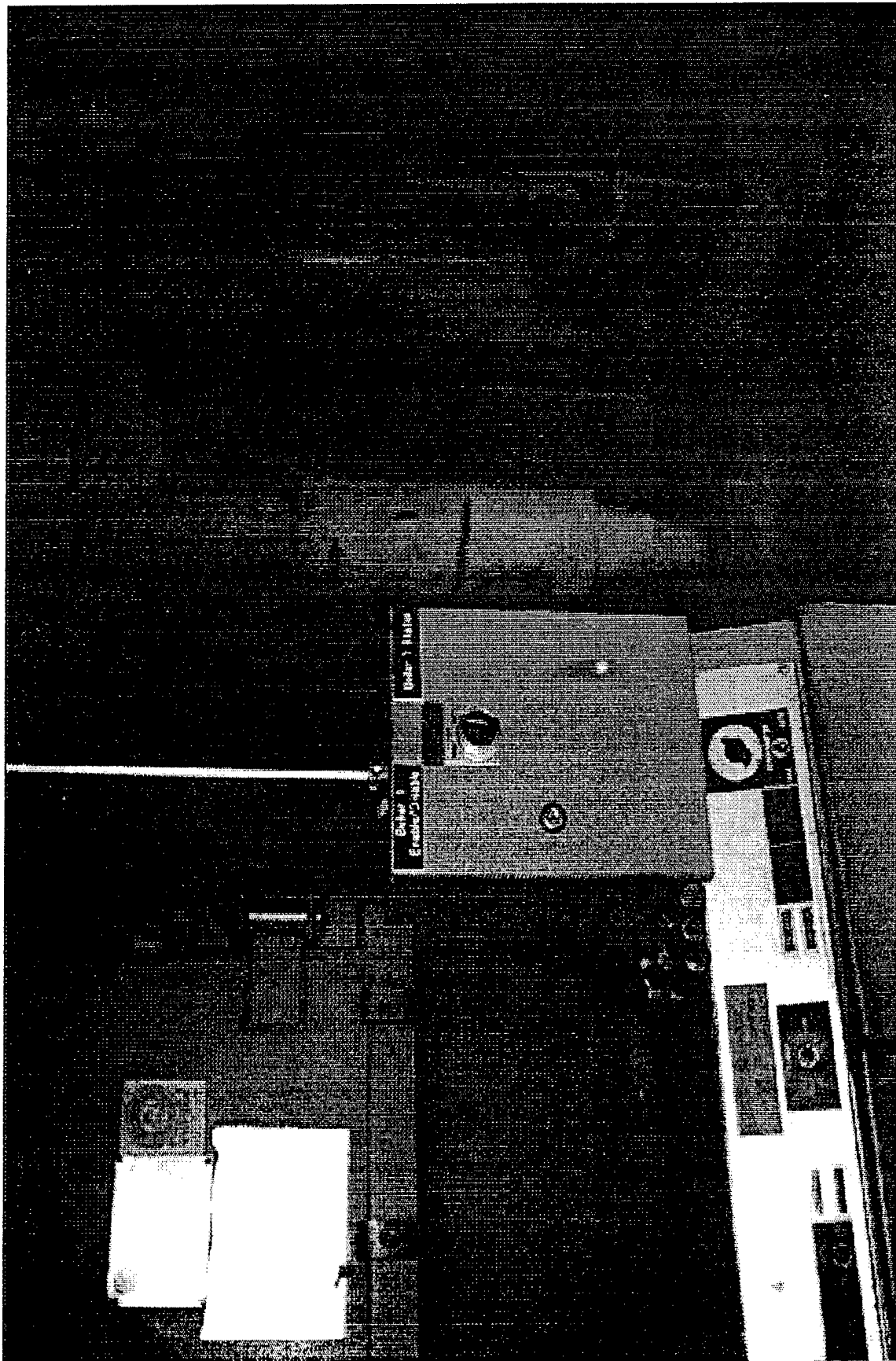
Energy Savings	365 MBtu/yr
Cost Savings	\$3,280/yr
Investment	\$26,074
SIR	1.80
SPB	7.95 yrs

## ECO-10: EMCS Expansion

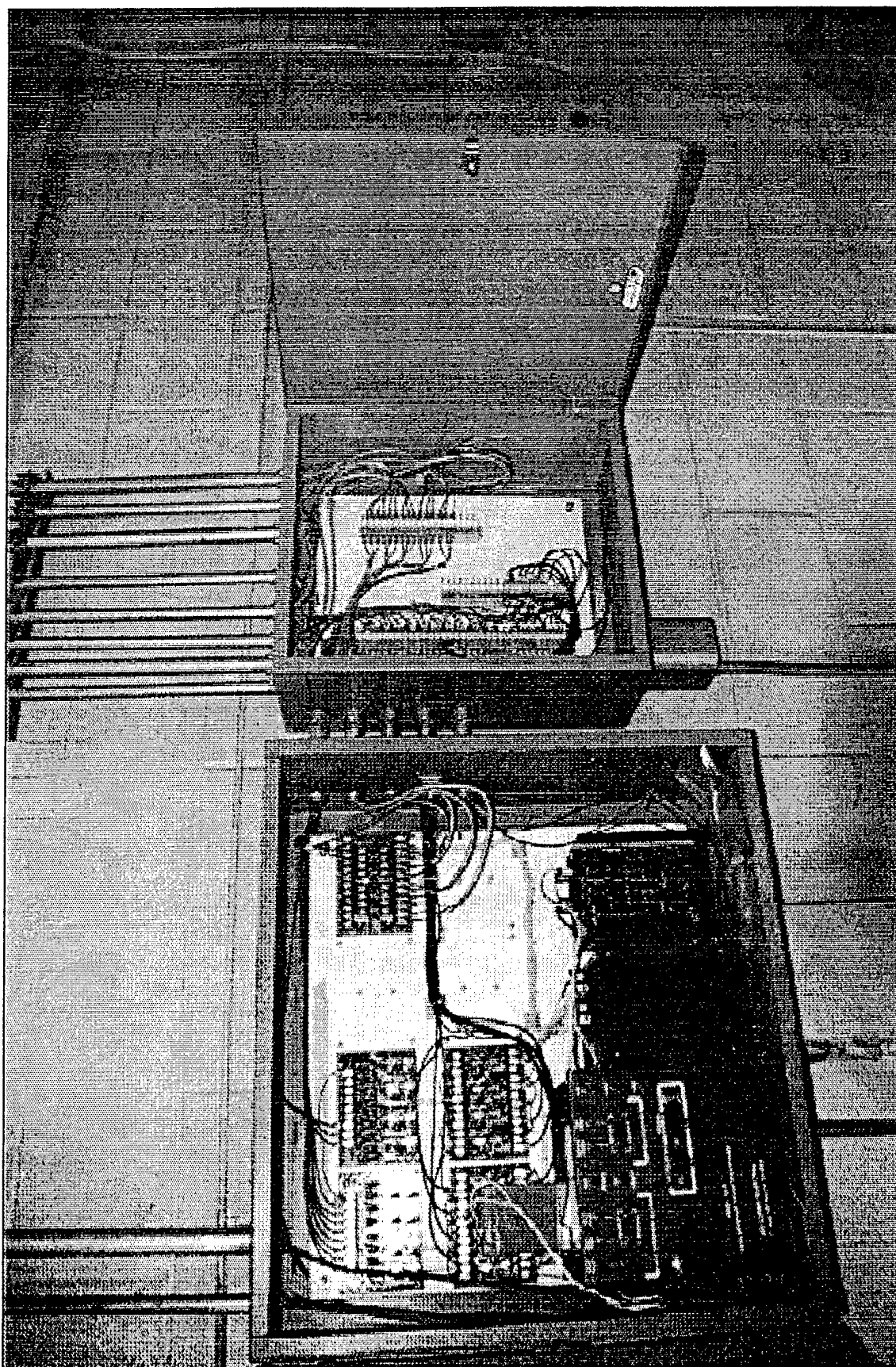
- 17 Buildings Surveyed

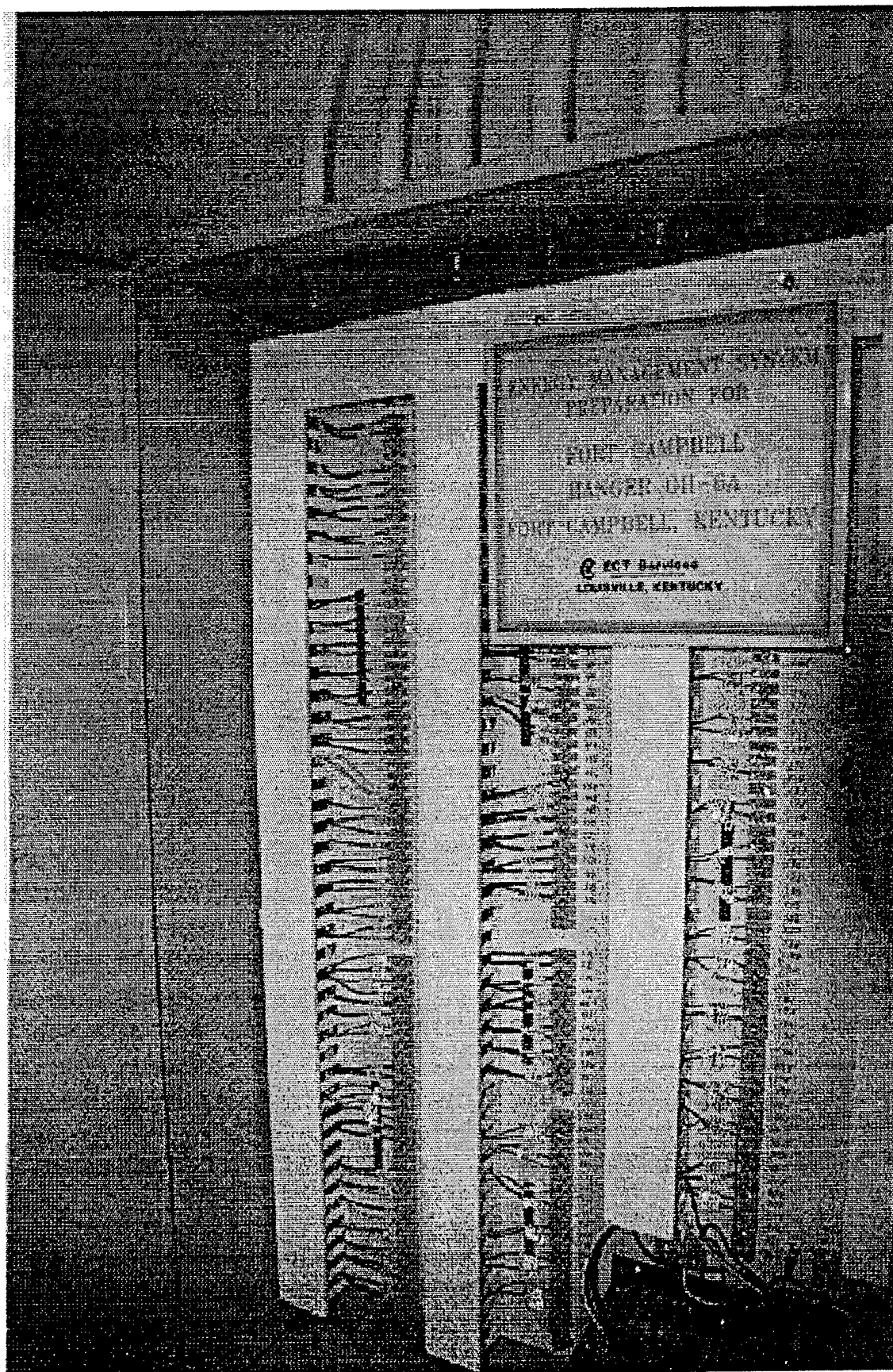
## ECO-10: Information Collected

1. Motor Sizes
2. Current Time Clock Utilization
3. Boiler, Chiller, and Air Handling Unit Information









## ECO-10: Analysis Summary

Energy Savings	13,689 MBtu/yr
Cost Savings	\$70,889/yr
Investment	\$481,924
SIR	1.32
SPB	6.80 yrs

## ECO-11: Commissary Lighting

- Building 2702 Surveyed

# ECO-11: Information Collected

1. Building Hours of Use
2. Existing Fixture Type and Number
3. Ballast Wattage
4. Lamp Wattage

## ECO-11: Analysis Summary

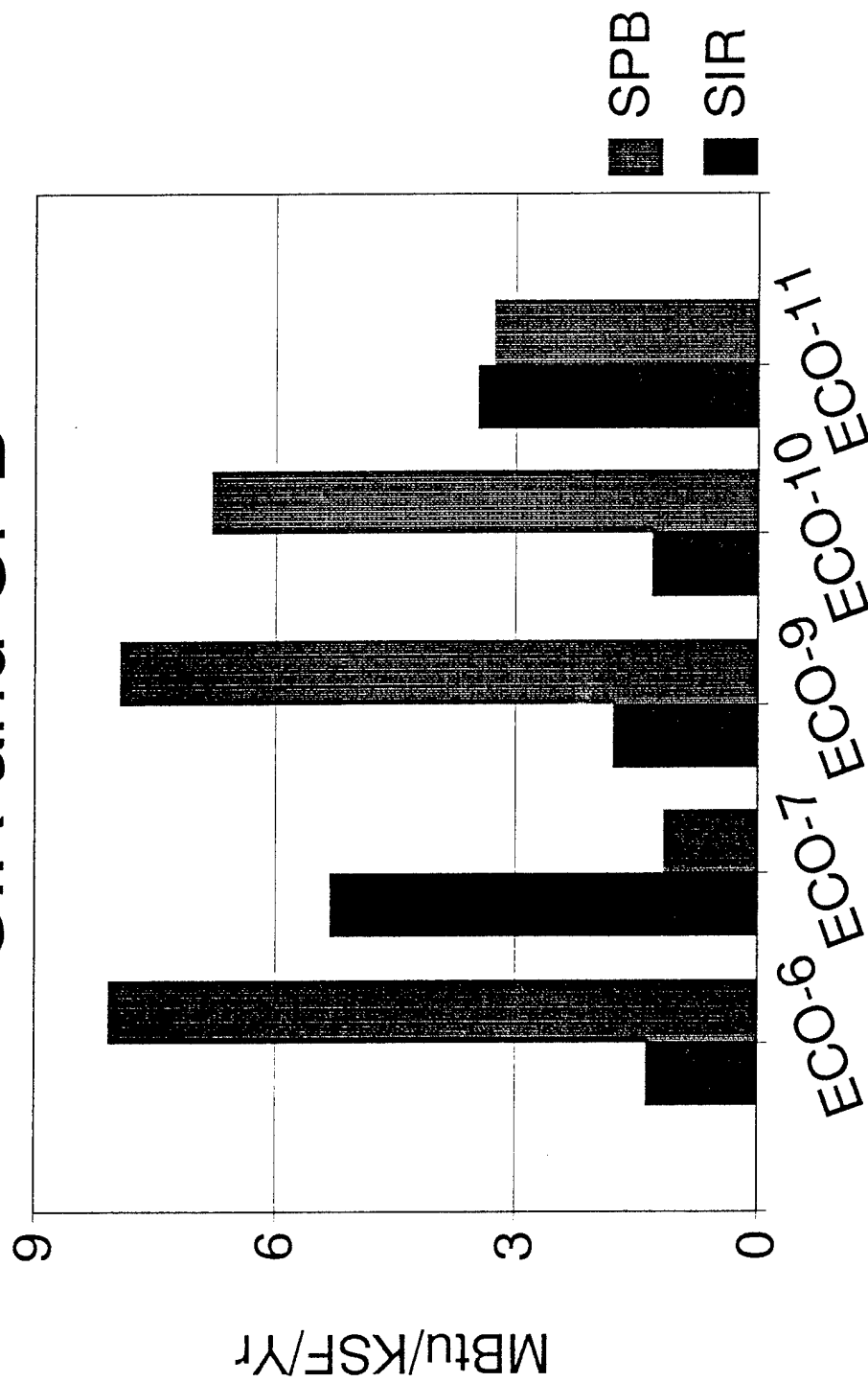
Energy Savings	3,078 MBtu/yr
Cost Savings	\$39,904/yr
Investment	\$130,696
SIR	3.48
SPB	3.28 yrs

# Fort Campbell ECO Comparison

## Investment Costs

ECO-6	\$349,993
ECO-7	49,913
ECO-9	26,074
ECO-10	481,924
ECO-11	130,696

# Fort Campbell ECO Comparison SIR and SPB





## 6 NAF LIGHTING

The ECO evaluation consisted of determining appropriate lighting replacements to improve lighting system efficiency while achieving recommended illumination levels. The ECO includes comprehensive lighting replacements.

TABLE 6.1	
LIGHTING SYSTEM REPLACEMENTS	
EXISTING LIGHTING	REPLACEMENT LIGHTING
T-12 Fluorescent Fixture	T-8 Fluorescent Fixture with reflector
T-12 Lamp	T-8 Lamp
Magnetic Ballast	Electronic Ballast
Incandescent Fixture	Compact Fluorescent Fixture
Incandescent Lamp	Compact Fluorescent Lamp and Ballast
Incandescent Exit Sign	LED (Light Emitting Diode) Exit Sign

This section contains the analysis results for the indoor lighting study for Building 6902 classified as non-appropriated funding (NAF). Included in this section are the life cycle cost analysis, energy calculations, and cost estimate for the facility.

The life cycle analysis, Sections 3A and 3B, refers to non-energy savings or costs present. For this project, Section 3A, Annual Recurring, reflects maintenance savings available by replacing the existing lighting systems. The new fixtures, due to the use of reflectors, have fewer lamps which saves on material and labor replacement. Compact fluorescents are rated for 10,000 hours versus 750 hours for an incandescent lamp which saves labor for replacements. LED exit signs have similar savings.

Section 3B, Non-Recurring Savings/Costs, refers to the replacement of parts of the existing lighting system. Many fluorescent fixtures surveyed were approaching the end of their economic life. On the spreadsheets included for fluorescent fixture replacement for each building, the higher wattage fixture for each type was replaced in this section. Mercury vapor fixtures were also replaced in 3B due to the termination of their manufacturing in the year 2000.

PRE-FINAL REVIEW PHASE II  
MEETING MINUTES  
NOVEMBER 10, 1993

ATTENDANCE LIST:

Charles L. Lockman	Louisville District COE, CEORL-ED-MS	(502) 582-6040
Arlin E. Wright	Ft. Campbell DPW-MESB	(502) 798-8895
Len May	Ft. Campbell DPW	(502) 798-8994
Larry Martin	Ft. Campbell DPW	(502) 798-5082
Keith Derrington	Systems Corp Project Manager	(615) 521-6536
Cheri Martin	Systems Corp Project Engineer	(615) 521-6536

The Pre-Final Review Meeting for Phase II began at 8:00 a.m. Charles Lockman began the meeting with a brief introduction. The Phase II meeting is the last meeting for the Ft. Campbell project. Pre-Final review comments from Mr. Lockman and Naresh Kapur (FORSCOM engineer) were distributed.

Systems Corp conducted a slide presentation summary for the results of the Pre-Final report for Phase II. The presentation showed the results obtained for two (2) ECIP projects, a Commissary Lighting project, and a NAF Facility Lighting project. The project groupings were determined at the previous review meeting on October 22, 1993.

The final report for Phase I will be submitted on November 12, 1993. The final report for Phase II will be submitted on November 24, 1993. The remainder of the meeting was spent discussing possible future ECO's for evaluation at Ft. Campbell.

The meeting was adjourned at approximately 9:00 a.m.

PRE-FINAL REVIEW PHASE II COMMENTS AND RESPONSES

Reviewer: Charles Lockman

Comment 1	General	Systems Corp has been very cooperative and when an ECO such as ECO 8, particularly, were not turning out to have a good return, they dug in and searched out projects meaningful for the installation savings. ECO 8 was the one that was not working and they worked on "Improve Commissary Lighting Efficiency" ECO, and also the ECO 7 "Peak Shaving Generators." Thanks for the top considerations that would afford Ft. Campbell savings.
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Response:	No response required.
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Comment 2	General	The COE recognizes the well organized documents and reports that give the story on each ECO through an Interim, Pre-Final, and eventually the Final Reports required for an ESOS documentation. We, the Louisville District COE, appreciate the experience in Energy Projects which show up constantly by Systems Corp reports and findings.
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Response:	No response required.
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Comment 3	General	Round off dollar figures on DD1391's.
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Response:	Will comply.
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### 13 PRE-FINAL REVIEW COMMENTS AND RESPONSES

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Comment 4      General      Submittal of the Pre-Final from the Interim was noted in a timely and quick response. Thanks!

Response:      No response required.

Reviewer: Naresh Kapur

Comment 1      General      Systems Corp staff has done a wonderful job of revising and reorganizing this submittal, especially in a very tight time schedule. Our compliments to them.

Response:      No response required.

Comment 2      General      This submittal is organized differently as compared to Interim submittal. It would be helpful to provide a little bit of explanation. What went where? What has been omitted? What has been added? Are we expected to pick up anything from Interim submittal?

Response:      The Interim Report contains the LCCA for each building for each ECO. Please refer to Interim Report for material omitted in this submittal. Please retain Interim Report for future reference regarding specific information for each building.

Comment 3      General      Refer to FORSCOM comment numbers 1,2,3,5,6,10, and 11. We like to know where can we find compliance or explanations? Due to reorganization of this submittal we may have missed the info provided.

Response:      In reference to the following:

*Comment 1* - Will provide as a separate submittal.

### 13 PRE-FINAL REVIEW COMMENTS AND RESPONSES

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*Comment 2* - Titles will be added where applicable throughout the Final report.

*Comment 3* - Catalog type information is included at the end of each programming document. Refer to page 3-1 for description of ECO.

*Comment 5* - Please refer to page 5-1 of Final report.

*Comment 6* - Please refer to page 5-1 of Final report.

*Comment 10* - Please refer to page 4-1 of Final report.

*Comment 11* - Please refer to page 4-1 of Final report.

Comment 4      Volume 1

The following items may be noted for appropriate action.

- A. Table of Contents, Item 6. Should it be 'NAF' rather than 'MAF'?

Response:

Yes. It will be corrected.

- B. Add title next to ECO # wherever it appears as a para title or tabulation title. This will be appreciated by reviewers. For example, pg 3-26 and pg 3-27.

Response:

Will comply.

- C. Executive summary, pg 1-11. Pl explain where can we find all the backup info related to ECIP-1, Lighting? The DD1391 for ECIP#1 on pg 3-18 to 3-29 give different figures. Need to elaborate what is what.

Response:

Will comply on explanation. The figures are different due to an error. This will be corrected for Final report.

### 13 PRE-FINAL REVIEW COMMENTS AND RESPONSES

- D.* Round off the dollar figures on DD1391 IAW ECIP guidance.

Response: Will comply.

- E.* Pg 3-26. Some of the building show SIR less than 1.25 and payback more than 10 yrs. Can we take a second look at them to improve the economics? If nothing works, make these buildings a part of OMA project(s).

Response: The analysis performed was determined to have the best results possible. The cost estimates, calculations, and life cycle cost analysis for each facility are included in the Interim submittal for possible O&M projects.

- F.* Building numbers on pg 3-18 and pg 3-26 do not match. Add a note of explanation if not already done.

Response: This is a typing error and will be corrected in Final Report.

Comment 5      Volume 1-3      Make sections 3-5 more user friendly by adding a table of contents at the beginning of these sections. List pg #, ECO #, and building # as applicable.

Response: Will comply.

Comment 6      Volume 2      Pg. 4-27. Explain how this LCCA summary was prepared. Do you have separate LCCA summary for ECO #7,9, and 10. Provide copies to Ft. Campbell rep.

Response: Will comply.

Comment 7    Volume 3

On pg 5-1, present the info from pg 5-2 thru 5-4 in laymann's language. Usually funding is handled by non-technical managers. See what can be done.

Response:

Will comply. Refer to page 5-1.

Comment 8    Volume 3

Pg. 6-1. Do something similiar to pg. 5-1.

Response:

Will comply. Refer to page 6-1.

Comment 9    Volume 3

Add titles to ECO's and photographs as appropriate.

Response:

Will comply.

# ENERGY SAVINGS OPPORTUNITY SURVEY

Fort Campbell, Kentucky

*Phase II - Prefinal Review*



# WORK ACCOMPLISHED TO DATE

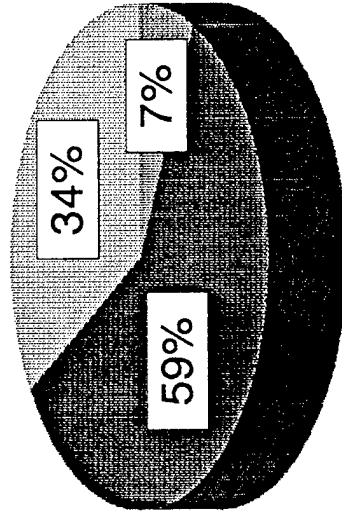
1. Field Surveys Completed for 133 Buildings
2. Exterior Lighting Surveys for 5 FH Areas
3. Baseline Energy Models
4. Evaluation of 121 Energy Conservation Opportunities
5. Calculations and Reporting of Solid Energy Conservation Opportunities for Possible Implementation
6. Preparation and Completion of all Field Notes
7. Completion of Interim Report
8. Completion of Prefinal Report

## REMAINING PHASES

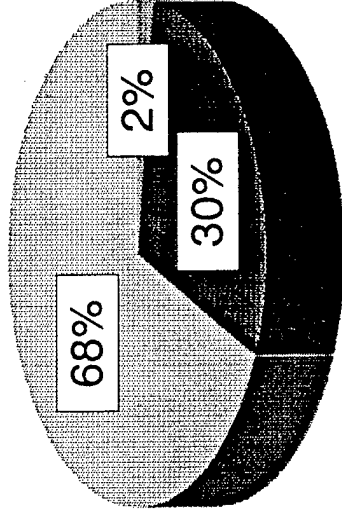
- Response to Prefinal Review Comments
- Final Report

# Fort Campbell Consumption vs. Cost

FY92



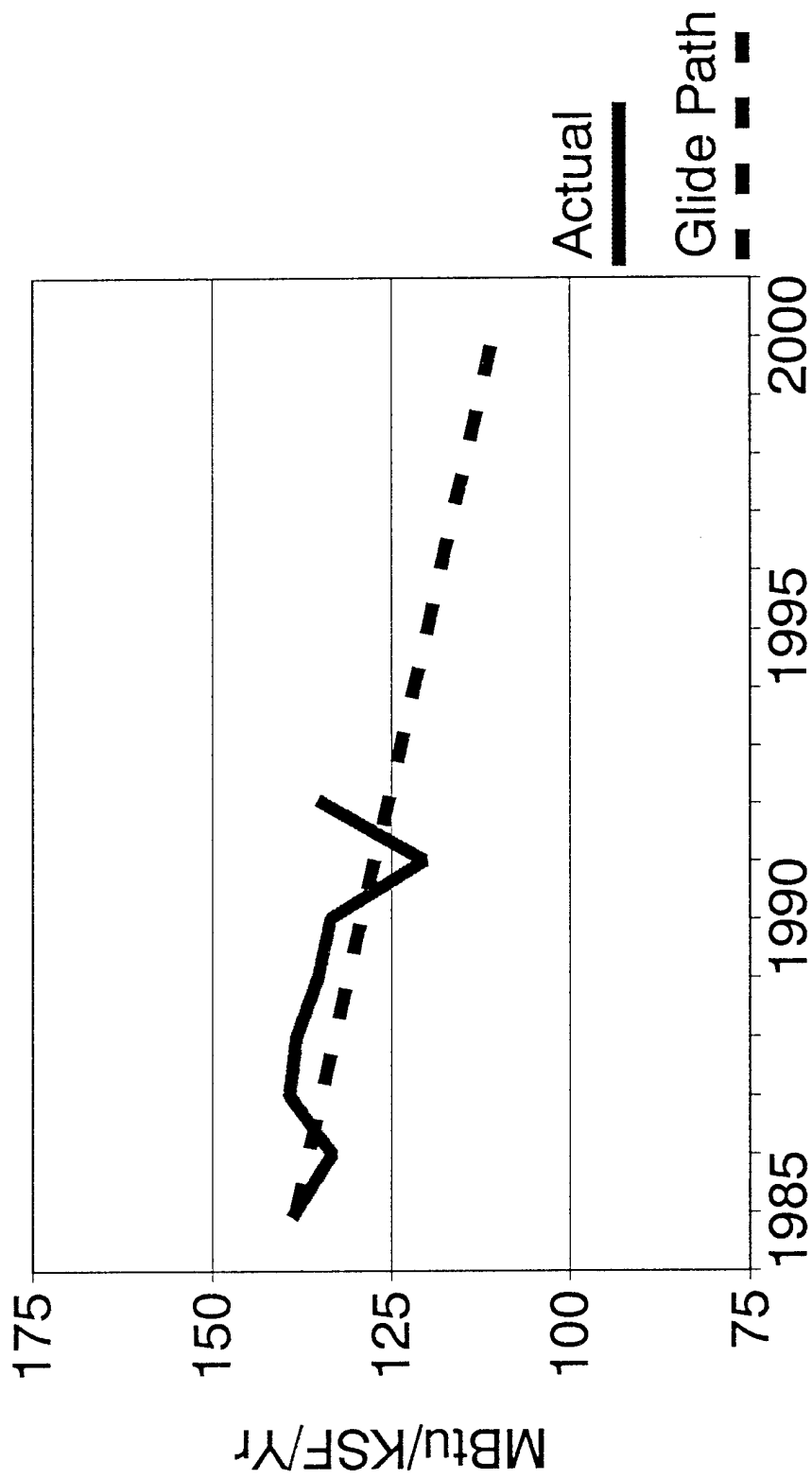
2,379,660 MBtu



\$16,599,000

Electricity    Natural Gas    Other

# Fort Campbell Energy Consumption



# FT CAMPBELL ENERGY COSTS

Electric	
<i>Energy</i>	\$6.19/MBtu
<i>with Demand</i>	\$13.48/MBtu
Natural Gas	\$4.00/MBtu
Fuel Oil	\$4.98/MBtu

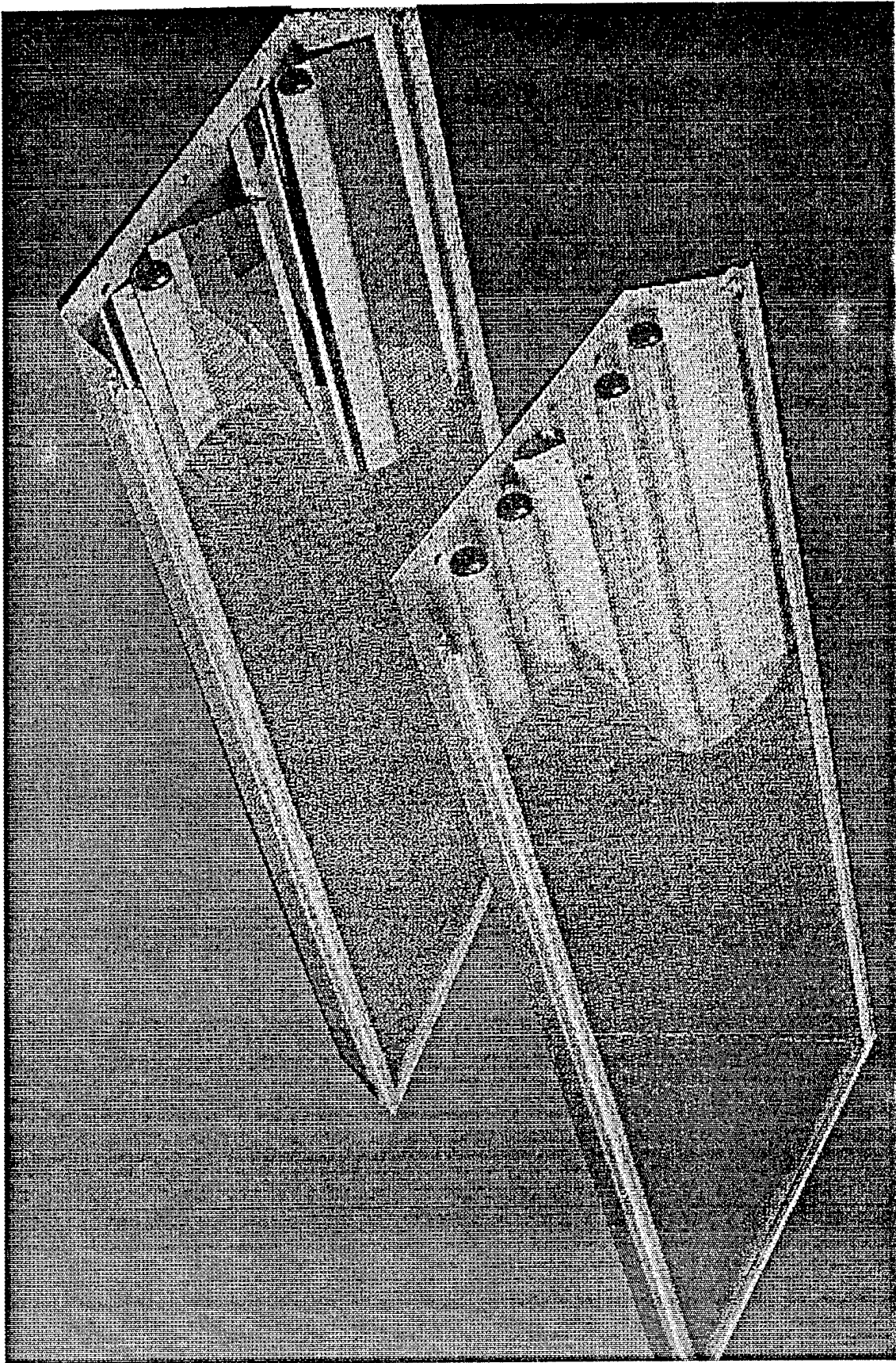
# PROJECTS

1. Lighting
2. Peak Shaving Generators/VSD/EMCS
- \*3. Commissary Lighting
- \*4. NAF Lighting

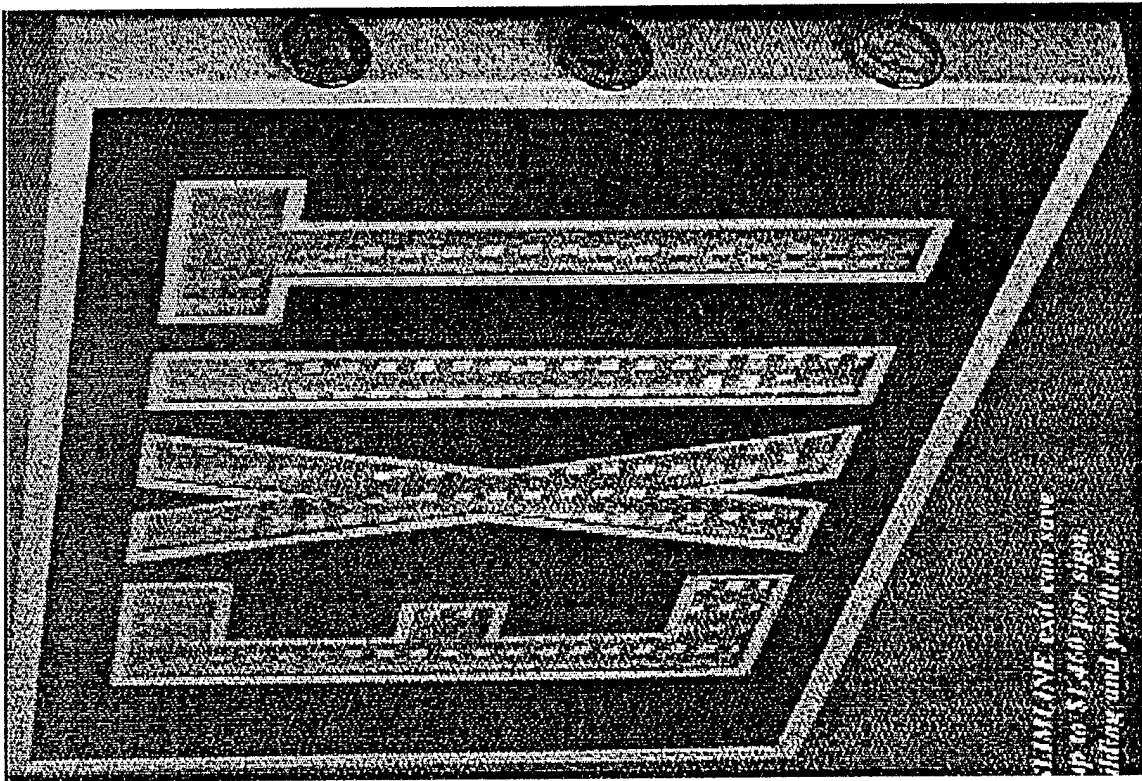
\* Programming documents not prepared for these projects

## PROJECT 1: Indoor/Outdoor Lighting

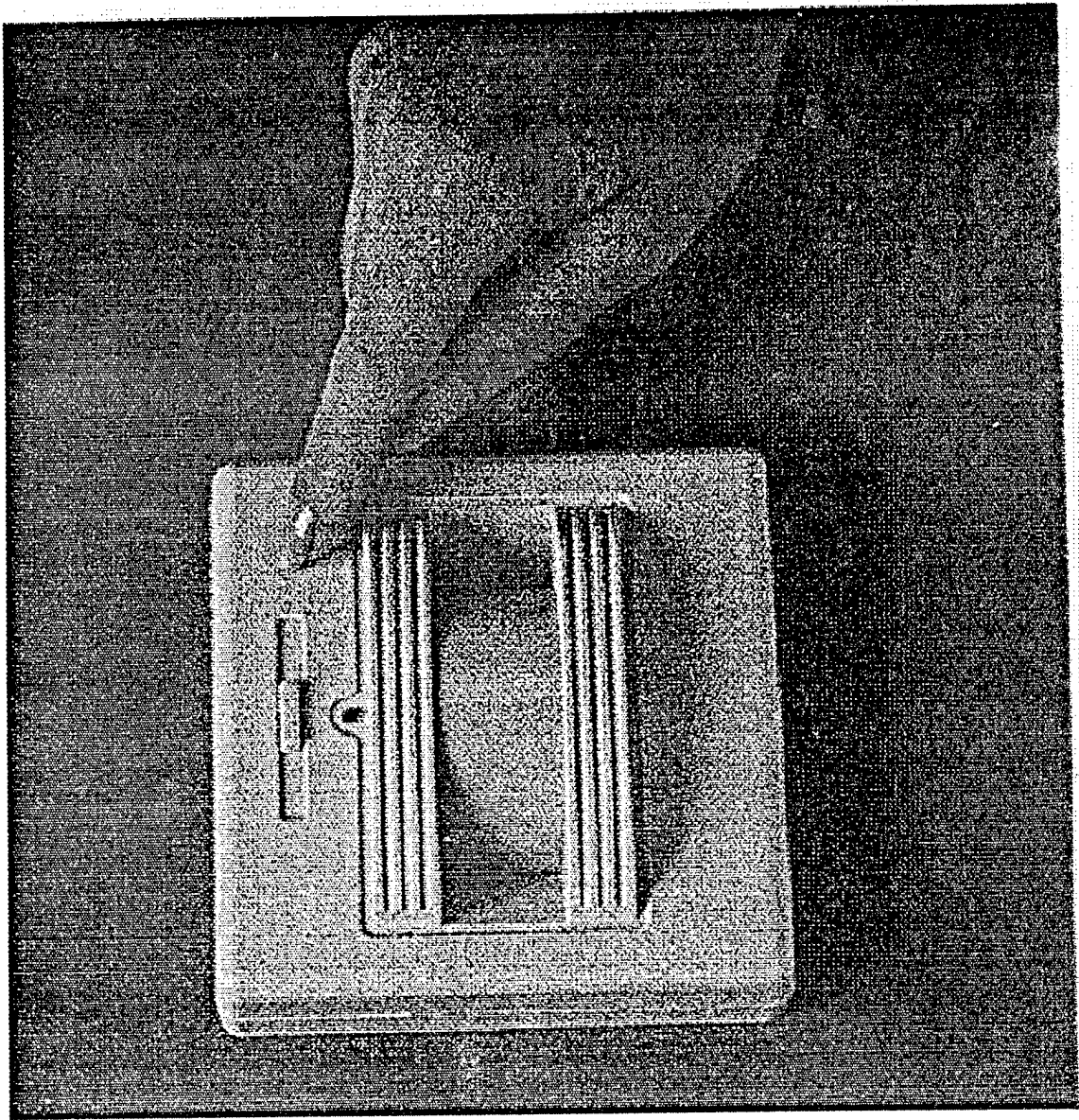
Energy Savings	1,800 MBtu/yr
1st Year Savings	\$44,078/yr
Investment Costs	\$342,581
SIR	1.44
SPB	7.77 yrs





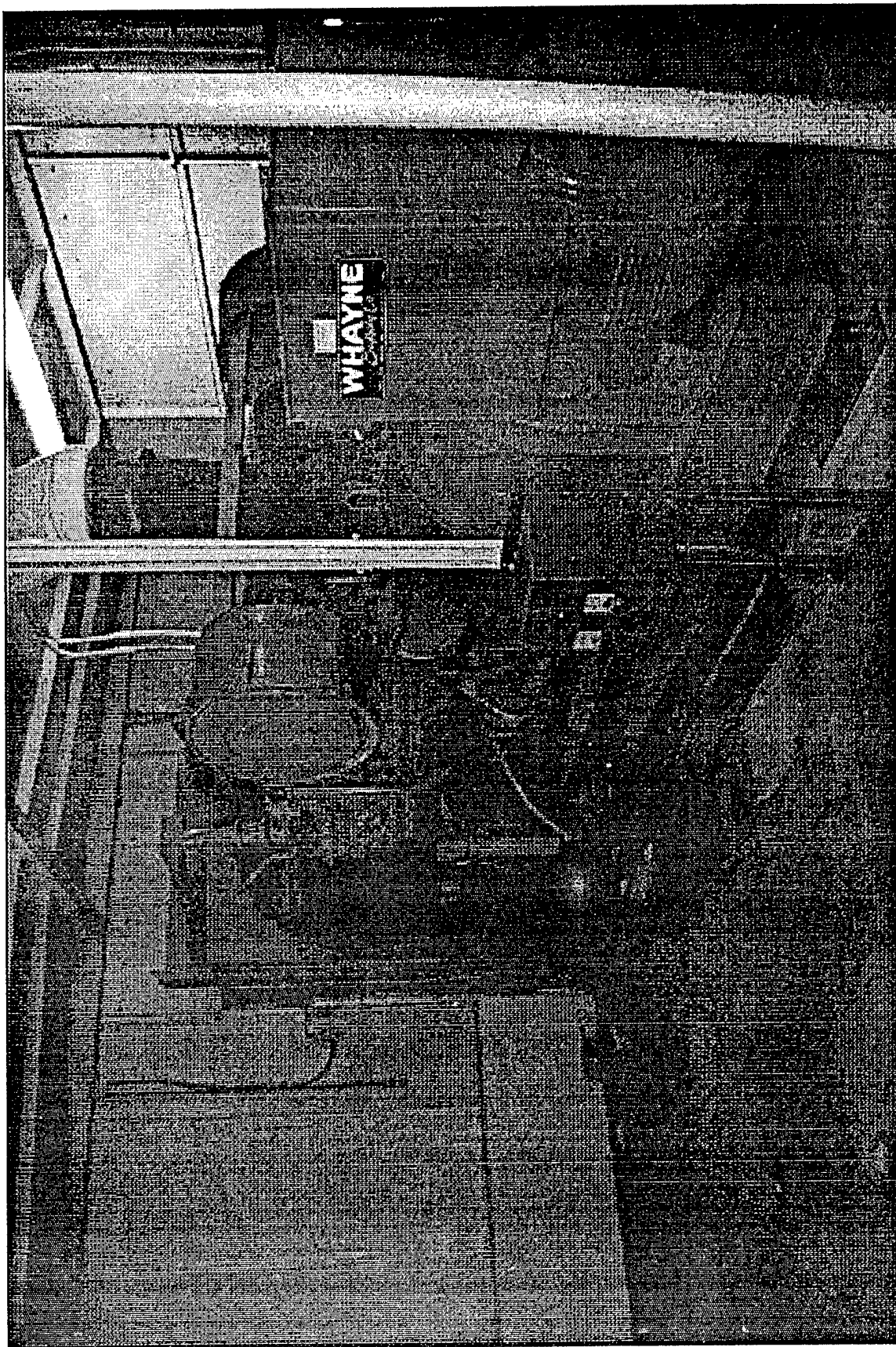


SLIMLINE exit can save  
up to \$1,460 per sign.  
sliding and you'll be

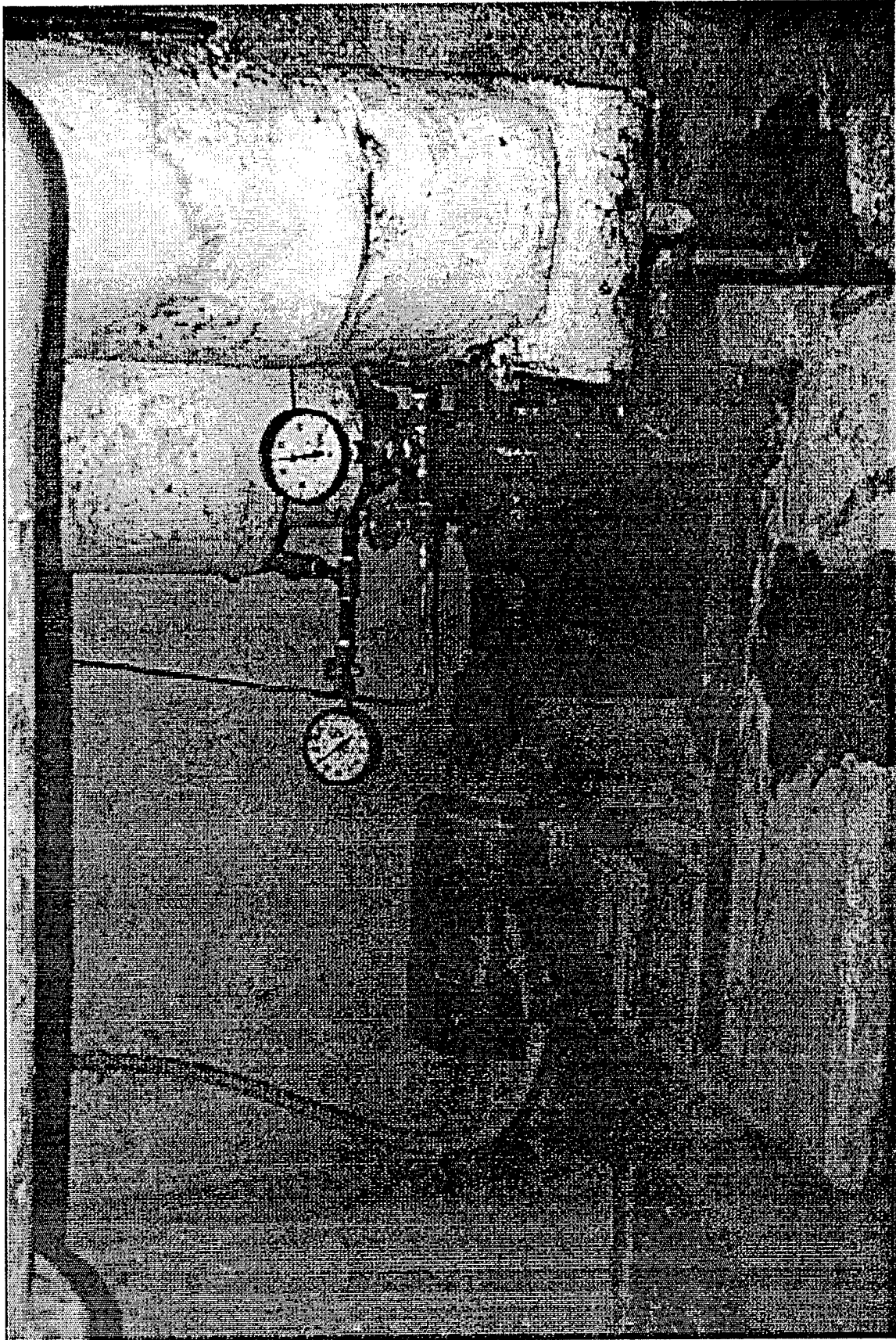


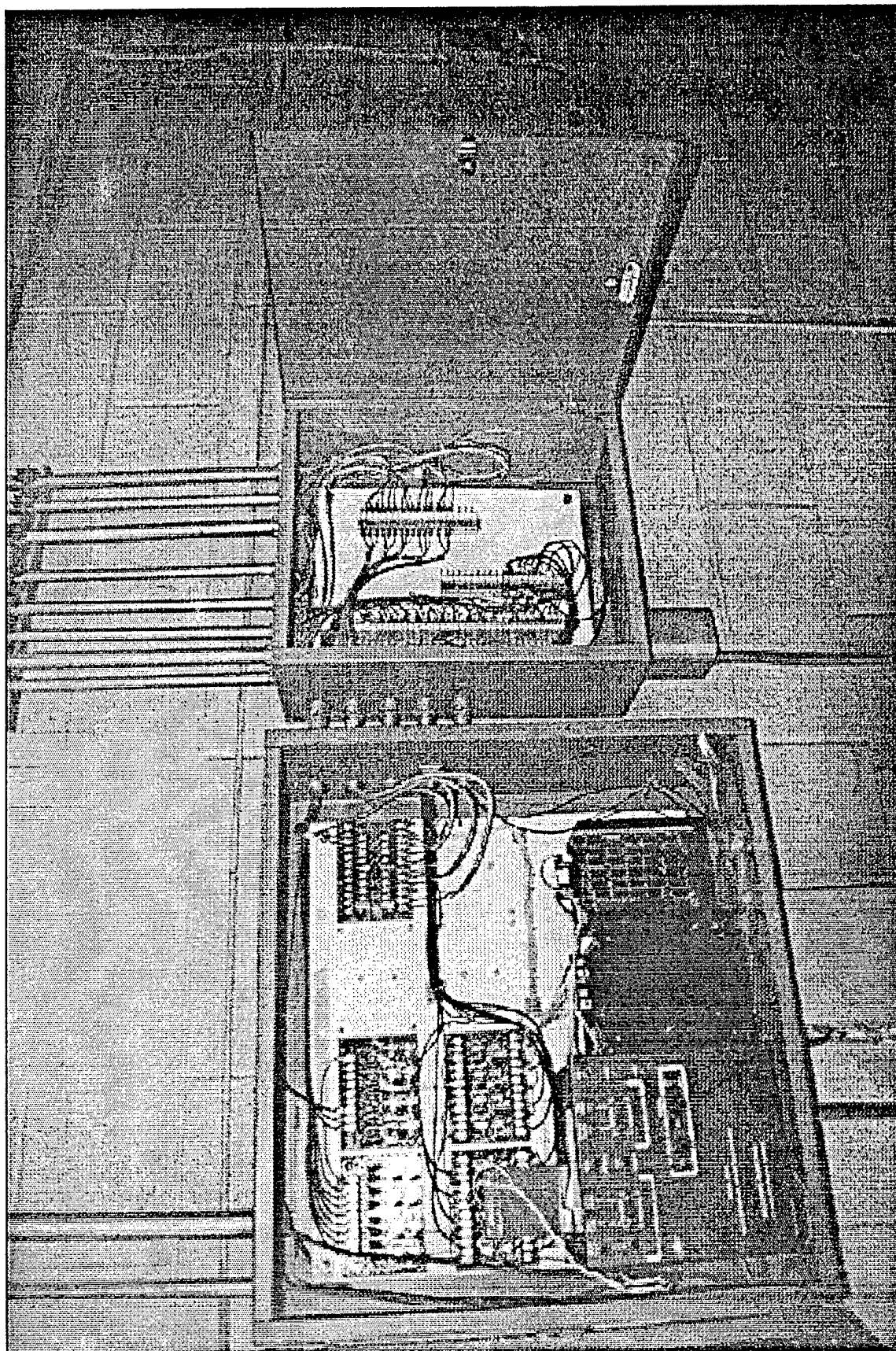
## PROJECT 2: Generators/VSD/EMCS

Energy Savings	1,162 MBtu/yr
1st Year Savings	\$116,922/yr
Investment Costs	\$543,236
SIR	2.77
SPB	4.65 yrs

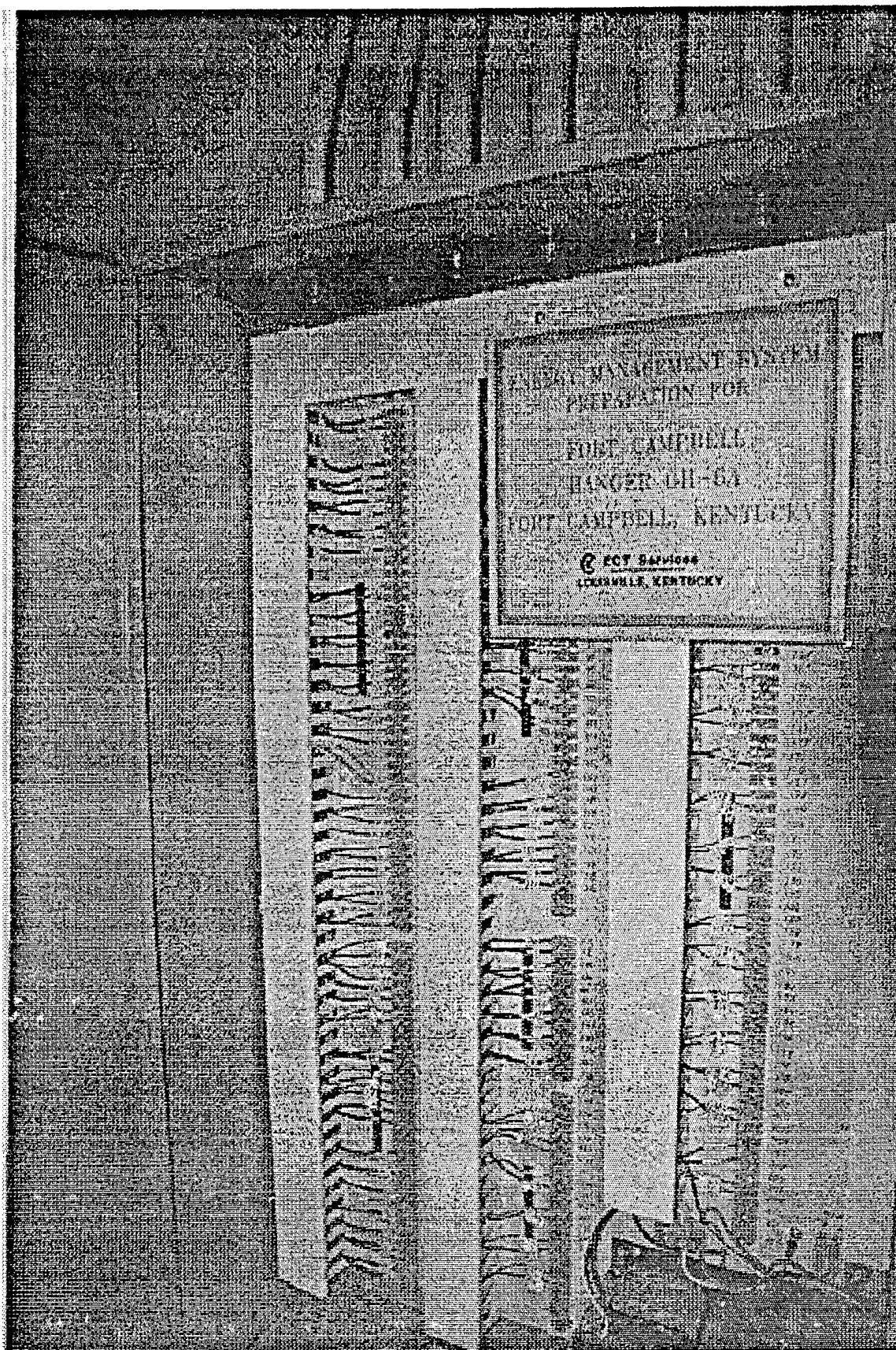












## PROJECT 3: Commissary Lighting

Energy Savings	3,078 MBtu/yr
1st Year Savings	\$39,904/yr
Investment Costs	\$130,696
SIR	3.48
SPB	3.28 yrs



## PROJECT 4: NAF Lighting (Bldg 6902)

Energy Savings	48 MBtu/yr
1st Year Savings	\$1,218/yr
Investment Costs	\$7,422
SIR	1.84
SPB	6.09 yrs

# PROJECT SUMMARY

	<i>1st yr Savings</i>	<i>Investment</i>	<i>SIR</i>	<i>SPB (yrs)</i>
Lighting	\$44,078	\$342,581	1.44	7.77
Gen/VSD/EMCS	\$116,922	\$543,236	2.77	4.65
Commissary Lighting	\$39,904	\$130,696	3.48	3.28
NAF Lighting	\$1,218	\$7,422	1.84	6.09
<b>TOTAL</b>	<b>\$202,122</b>	<b>\$1,023,935</b>		

# PROJECT COMPARISON SIR and SPB

